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METALLURGY SALES OPERATIONS

News Digest

Economy-in-Production Is Theme of 1949 National Metal Congress

Cleveland, Ohio will once more be the scene of the National Metal Congress and Exposition, which gets underway Oct. 17, 1949. During the two days preceding this event, an ASM seminar will be held on "Thermodynamics in Physical Metallurgy."

As has been the case in recent years, the Metal Congress will be sponsored jointly by the American Society for Metals; American Welding Society; Metals Branch, American Institute of Mining & Metallurgical Engineers; and the Society for Non-Destructive Testing.

This year the Metal Show, as it is more generally known, will stress "Economy-in-Production." The theme will be advanced in eight panel type discussions covering cleaning and finishing, press work, welding, heat treating, alloys and adaptable mill products, precise metal forms, metallurgy in machine shop operations and brazing, soldering and welding sub-assemblies.

Technical sessions of the ASM and AWS will be held throughout the week, with the ASM sessions being held in the Public Auditorium. AWS papers will be presented at the Cleveland Hotel. The technical meeting of AIME will start Monday and continue through Wednesday at the Allerton Hotel. Morning and afternoon technical sessions will be held by the Society for Non-Destructive Testing at its headquarters, the Hotel Statler.

The exposition, held in conjunction with the technical meetings, will be staged in the Cleveland Public Auditorium, with more than 300 firms scheduled to exhibit their products and services.

Individuals Honored

Dr. Marcus A. Grossman, Director of Research, Carnegie-Illinois Steel Corp., is to be presented the Saveur Achievement Award at the annual ASM dinner Thursday, Oct 20, at the Hotel Statler. At the same dinner Dr. E. C. Bain, vice-president, Carnegie-Illinois Steel Corp., will be awarded the ASM Gold Medal. A third ASM award, the Medal for the Advancement of Research, will go to Fred H. Haggerson, president, Union Carbide & Carbon Corp.

American Welding Society Awards include the Samuel Wylie Miller Memorial Medal to A. G. Bissel, Principal Engineer, Bureau of Ships, Navy Department, and the Adams Lecture Award to W. M. Wilson, Professor of Structural Engineering, University of Illinois.

There follows a correlated program of the participating societies, plus schedules of educational lectures and panel discussions:

Correlated Program of Technical Sessions

National Metal Congress, Cleveland, Ohio, October 17-21, 1949

Monday, October 17

A.M.

9:00 AIME Precipitation and Aging, Allerton Hotel
AIME Fracture and Strain Phenomena, Allerton Hotel
AIME Recrystallization, Allerton Hotel

9:30 ASM Alloy Steels—I, Auditorium
AWS Structural Design, Hotel Cleveland
AWS Pressure Vessels, Hotel Cleveland
AWS Hard-Facing and Flame Hardening, Hotel Cleveland

PM

2:00 ASM Alloy Steels—II, Auditorium
AIME Equilibrium Diagrams, Allerton Hotel
AIME Fracture and Strain Phenomena, Allerton Hotel
AIME Electrical Properties of Alloys, Allerton Hotel
AWS Nonferrous Metals, Hotel Cleveland
AWS Education, Hotel Cleveland
AWS Research, Hotel Cleveland

8:00 AWS Adams Lecture

Tuesday, October 18

A.M.

9:00 AIME Transformations, Allerton Hotel
AIME Fracture and Strain Phenomena, Allerton Hotel
AIME Surface Orientation—Phase Relationships, Allerton Hotel

9:30 ASM Oxidation, Auditorium

(Continued on page 54)

Correlated Program (continued)

Panel Discussions

Monday, Oct. 17	2:00 p.m.	—Economy-in-Production Through Better Cleaning and Finishing Methods
	8:00 p.m.	—Economy-in-Production Through Improved Press Shop Operations
Tuesday, Oct. 18	2:00 p.m.	—Economy-in-Production Through Improved Welding Techniques and Equipment
	8:00 p.m.	—Economy-in-Production
Wednesday, Oct. 19	2:00 p.m.	—Economy-in-Production Through the Use of Tailor Made Alloys or More Adaptable Mill Products
	8:00 p.m.	—Economy-in-Production by the Use of Brazing, Soldering and Welding for Sub Assemblies

(All sessions at the Public Auditorium)

Educational Lectures

ASM Machining Theory and Practice
Monday—4:15 p.m. and 8:00 p.m.
Tuesday—4:15 p.m. and 8:00 p.m.

ASM Stress Corrosion in Metals
Wednesday—4:15 p.m., 5:15 p.m., 8:00 p.m.

AWS Designing for Welding
Monday, Tuesday, Wednesday—4:30 to 6:00 p.m.

(ASM Lectures at Auditorium—AWS Lectures at Hotel Cleveland)

ASM Quenching, Auditorium
AWS Symposium on Ship Structure Research, Hotel Cleveland
AWS Resistance Welding, Hotel Cleveland
AWS Machinery Welding, Hotel Cleveland

PM
2:00 **ASM** High Temperature Metallurgy, Auditorium
AIME Transformations, Allerton Hotel
AIME Structure and Identity of Materials, Allerton Hotel
AIME Diffusion-Grain Boundaries, Allerton Hotel
AWS Symposium on Ship Structure Research, Hotel Cleveland
AWS Resistance Welding, Hotel Cleveland
AWS Miscellaneous, Hotel Cleveland

Wednesday, October 19

A.M.
10:00 **ASM** Annual Meeting; Campbell Memorial Lecture, Auditorium
AWS Apparatus, Hotel Cleveland
AWS Resistance Welding, Hotel Cleveland
AWS Aluminum, Hotel Cleveland
SNDT Non-Destructive Testing Techniques and Equipment, Hotel Statler

PM
2:00 **ASM** Transformation in Steels; Temper Brittleness, Auditorium
AIME Annealing Twins-Kink Bands, Allerton Hotel
AIME Powder Metallurgy, Allerton Hotel
AIME Titanium-Beryllium, Allerton Hotel
SNDT Industrial Applications of Non-Destructive Testing, Hotel Statler

Thursday, October 20

A.M.
9:30 **ASM** Stainless Steel, Auditorium
AWS Arcs and Electrodes, Hotel Cleveland
AWS Railroad, Hotel Cleveland
AWS Weldability, Hotel Cleveland
SNDT Non-Destructive Testing in Industrial Management, Hotel Statler

PM
2:00 **ASM** Mechanical Metallurgy, Auditorium
SNDT Lester Lecture, Hotel Statler
8:00 **AWS** Symposium—Importance of Welding to Management, Engineer and the Public

Friday, October 21

A.M.
9:30 **ASM** Atomic Energy Metallurgy, Auditorium
AWS Inert Gas Welding, Hotel Cleveland
AWS Stainless Steel, Hotel Cleveland
AWS Gas Cutting, Hotel Cleveland

PM
2:00 **ASM** Nonferrous Metals

The complete list of Exhibitors and their booth numbers will be found on page 191.

New Metal Casting Process Said to Combine Operations

Within the past few weeks, announcement has been made of a new casting process which is said to simultaneously cast, mold, forge and coin a product. The product so turned out is said to require 60 to 70% less machining normally required on a casting operation. At the same time, an increase of 10 to 40% in tensile and yield strength is said to result.

The Bacco process, as it is known, is reported to be suited to most castable metals, including aluminum, steel, brass, bronze and copper.

As explained by Harold Budds, head of Budds Aero Casting Co., owner and developer of the process, the basis of the process is in designing tools in such a way as to permit the pouring of the metal in a liquid state and applying pressure continuously to the point of solidification. This, in effect, combines the action of casting, molding, forging and coining.

Tool temperature is thermostatically controlled, and the metal temperature likewise is under careful control, with the result that parts can be cast to tolerances of from 0.001 to 0.002 in.

Developers say that the Bacco process results in a finer granular structure with virtually no porosity.

Scientists Agree on Changes in Names of Several Elements

Changes in the official names of several elements commonly used in alloys have been agreed upon by scientists representing 30 nations. While the names approved of will be used immediately in international relationships, official documents and scientific reports, there is some question as to how soon the most radical changes will find complete acceptance in this country.

The change in name of tungsten to wolfram is probably the most far reaching insofar as the United States is concerned, with columbium changing to niobium as the second drastic conversion. There was a move officially to designate beryllium as glucinium, but the name is to remain.

Tungsten has been the designation of this element for nearly a century in England and the United States although the chemical symbol "W" stands for wolfram.

In all, the names of thirteen elements have been decided upon, with further changes being studied. By atomic number, the names agreed upon are:

Four, Beryllium; Forty-one, Niobium (instead of Columbium); Forty-three, Technetium; Sixty-one, Promethium; Seventy-one, Lutetium (instead of Lutecium); Seventy-two, Hafnium; Seventy-four, Wolfram (instead of Tungsten); Eighty-five, Astatine; Eighty-seven, Francium (instead of Alabamine); Ninety-one, Protactinium (instead of Protoactinium).

In addition, four names used for new elements resulting from atomic research have been adopted officially. They are: Ninety-three, Neptunium; Ninety-four, Plutonium; Ninety-five, Americium; and, Ninety-six, Cirium.

As far reaching as some of these changes are, more drastic disruptions are due if further changes in terminology now under discussion are agreed upon when the group meets again two years hence. There is a "probability" that aurum will be used for gold; argentium for silver; stannum for tin; ferrum for iron; natrium for sodium; and kalium for potassium. All these instances would invoke the names for which the elements' symbols actually stand.

The agreement on designations was reported to the recent meeting of the American Chemical Society by Dr. Alexander Silverman of the University of Pittsburgh. The agreements were reached at a meeting of the International Union of Chemistry held in Amsterdam early in September. Dr. Silverman represented the United States on the Union's Commission on Names.

Titanium Producers Claim Large Size Ingot Output

Titanium metal, a material that is claiming the attention of many producers and potential users in recent months, seems to be making significant strides. At the recent meeting of the American Chemical Society, a symposium on titanium was told by du Pont's Dr. E. A. Gee that his company is now prepared to produce 400-lb. ingots of titanium regularly. Ingot size has increased rapidly from those of 10-lb. size up to the 100-lb. ingot and now the big ingots.

This news parallels that coming from Allegheny-Ludlum, large stainless steel producer, which has quietly entered the titanium field. Allegheny-Ludlum expects within a short time to produce 400-lb. ingots.

Considerable research on titanium is being carried on by the various producers and by many research organizations. Recently, the University of Kentucky announced that it is to conduct an intensive research program on the newest light metal.

Titanium metal is being offered for sale at about $20 per lb., but indications are that within the not too distant future this price will drop to a level that is more in the reach of industry in general.

Metal Powder Physicists Meet to Discuss Sintering Problems

A three-day symposium on the physics of powder metallurgy was recently held under the auspices of the metallurgical laboratories of Sylvania Electric Products, Inc. Leading U. S. and foreign authorities met to correlate recent advances in solid-state physics with engineering approaches to problems in powder metallurgy. The purpose was to promote a better understanding of the mechanics of sintering.

Twenty-three papers were read to the group attending, covering theories and mechanisms of sintering, self-diffusion, viscous flow, grain growth, nucleation, recrystallization and surface tension.

Of interest to users of powder metal parts was a paper presented by Dr. C. G. Goetzel of Sintercast Corp. of America. Dr. Goetzel, talking on hot pressing, reported that complete densification has been demonstrated for parts made from copper, gold, brasses, bronzes, steels and cemented carbides. Hot pressing was shown to give a marked improvement in hardness, compressive and tensile strengths, and ductility over conventional cold pressing methods. Dr. Goetzel pointed out that many problems remain to be worked out before commercial production of hot-pressed parts would be widely achieved.

British Use Aluminum Alloy as Cable Sheathing Material

British information sources indicate that a British company has completed development of aluminum sheathed cables for the transmission of electric power. The cable makers, Johnson & Phillips, Ltd., claim that this is the first application of aluminum sheathing.

Sheathed with seamless aluminum tubing, the new cables result in weight savings of from 20 to 70% over similar lead sheathed types. In addition to lightness, they offer higher tensile strength and

(Continued on page 140)

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High Strength Nickel Alloy Retains Performance Properties at High Temperatures

Unusually high strength at ordinary temperatures and at red heat is obtained by suitable heat treatment of Inconel X, a recently developed high-temperature alloy.

by C. A. CRAWFORD,

Development & Research Div.,

International Nickel Co., Inc.

● LATEST ACHIEVEMENT in the search for alloys suitable for gas turbine parts, requiring high strength and low plastic flow rate at temperatures up to or above 1500 F, is Inconel X, produced by the International Nickel Co., Inc. Resistant to chemical corrosion and oxidation, this alloy is the most recent of a long series of age-hardenable alloys evolved from Inconel.

Suitably heat-treated, Inconel X has unusually high strength, both at ordinary temperatures and at red heat. It is far stronger than Inconel, which is only slightly age-hardenable. It also has an appreciable advantage in strength up to 1800 F, although its superiority to the standard Inconel is less marked at temperatures above 1500 F. The decrease in tensile and yield strengths of the new alloy from room temperature up to 1100 F is very small, 90% of the tensile and yield strengths of the directly aged material being retained up to 900 F and 80% up to 1100 F. When the material is solution-treated and aged to obtain optimum properties above 1100 F, the yield strength at 1100 F is 90% of the room temperature value.

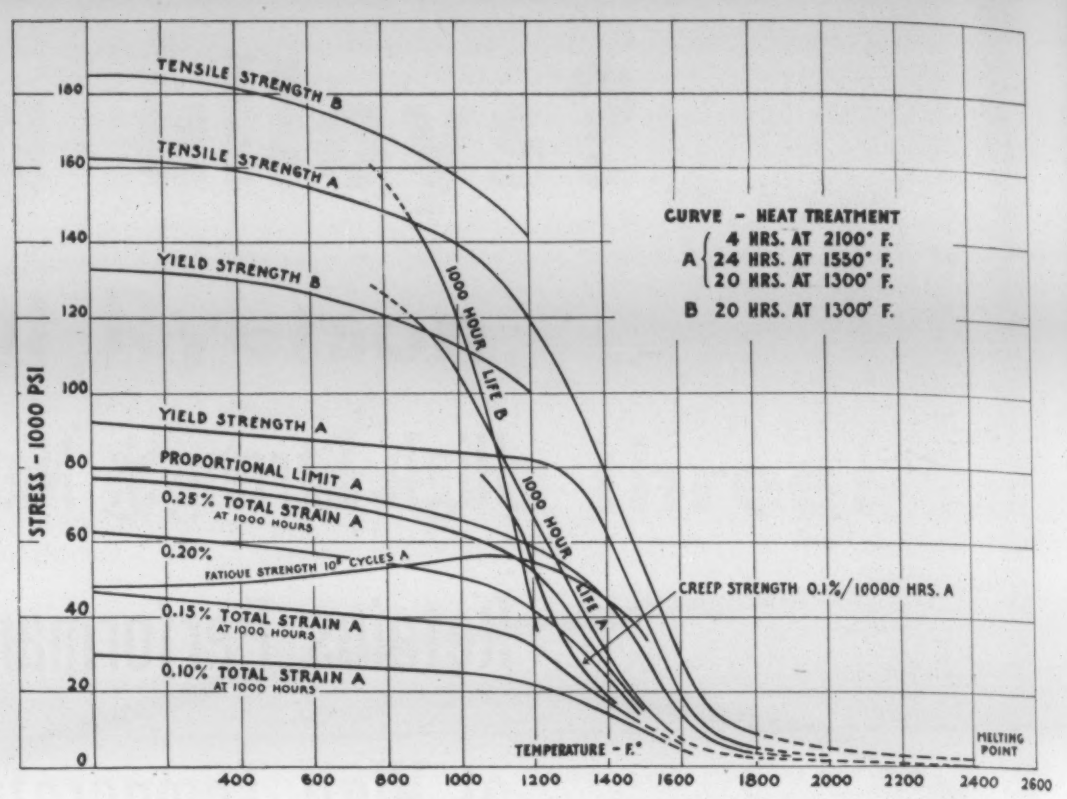
The high strength of the alloy is the result of composition and heat treatment and does not depend upon the common method of hardening austenitic alloys by so-called "hot cold work" (hot working below the recrystallization temperature). Heat treatment affords more uniform hardening from surface to center of large sections than can be obtained by "cold forging," which has progressively less effect toward the center. Cold finishing can be used to advantage for moderate temperature applications below 1100 F; for these applications, highest strength is obtained by aging directly after hot or cold work with an intermediate stress equalizing anneal for large sections. For applications above 1100 F, and where loads are to be sustained for long times, the useful strength of Inconel X is obtained only by the full heat treatment. Above 1500 F, the effect of age hardening is lost and the alloy is used in the annealed condition.

Comparative oxidation tests indicate that the oxidation resistance of Inconel X is of the same order as for the standard alloy at temperatures up to 1600 F. Above 1600 F, its oxidation resistance is less than that of standard Inconel. Production experience indicates that Inconel X can be forged, welded, and machined successfully, no unusual difficulties having been encountered.

Some alloys, which include large proportions of cobalt, tungsten and molybdenum, and are, in most cases, available only in cast or sintered forms, are stronger than Inconel X at 1500 F and at higher tempera-

tures. No wrought alloy produced in commercial quantities, however, meets a specification as high as Inconel X at 1350 F. Some alloys of comparable strength at 1200 to 1500 F contain cobalt and, in most cases, they also contain tungsten and columbium. Inconel X contains only the relatively plentiful metals—nickel, chromium, iron, manganese, aluminum and titanium—with 1% or less of columbium. The composition limits of the alloy are given below:

Nickel	70.00, min.
Chromium	14.00-16.00
Titanium	2.25-2.75
Columbium	0.70-1.20
Aluminum	0.40-1.00
Iron	5.00-9.00
Manganese	0.30-1.00
Silicon	max., 0.50
Copper	max., 0.20
Carbon	max., 0.08
Sulfur	max., 0.01



Strength vs. temperature of Inconel X using different heat treatments.

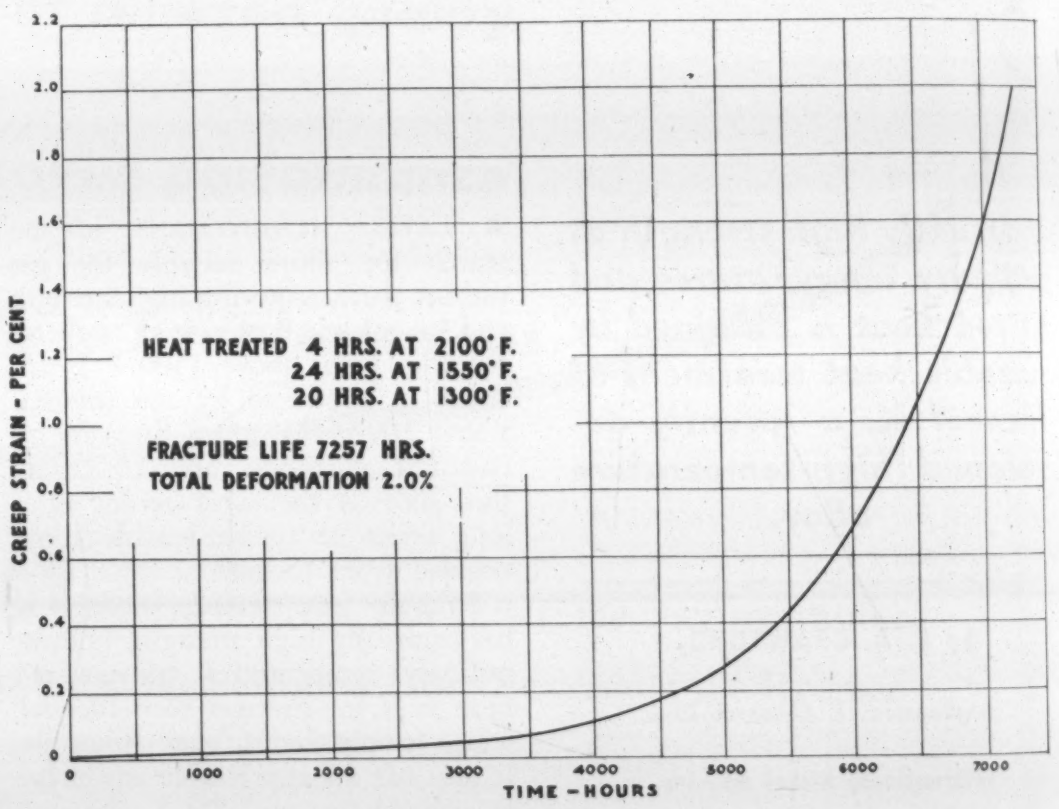
Applications of Inconel X

The exceptional strength of Inconel X at all temperatures from subzero to 1100 F make it especially useful where corrosive or oxidizing conditions exist under stress. It compares in strength with heat treated steels and retains its strength to temperatures beyond the drawing temperature of steels suitable for high temperature steam applications. Because of its high strength from subzero temperatures up to and beyond present day steam temperatures, the alloy is particularly adapted to bolts, springs, and all types of forgings or fabrications for supporting either static or dynamic loads where chemical attack renders simpler alloys unusable.

Inconel X is used for gas turbine rotor wheels, gas turbine blades and vanes. Bolts of the new alloy have been used successfully to fasten the assembly of outside supporting structures and housings of the combustion system in aircraft gas turbine engines, and in assemblies of multiple-stage turbines or other holding devices that operate at elevated temperatures.

Several laboratories have used Inconel X for specimen holder grips in tensile, stress rupture, creep and similar tests conducted at high temperatures. Because the methods employed require that the specimen holders remain in hot zones for the period of testing, which is frequently long, the temperature of the grips becomes almost as high as that of the test specimens.

Inconel X is expected to be useful at all temperatures up to 650 F as a



Creep vs. time of Inconel X.

particularly strong nonferrous spring material. The properties of the alloy as a spring from 650 to 950 F indicate future usefulness in this band of temperatures where little else is available except the tool steel type of alloy. Springs of this material are also expected to have some use at higher temperatures up to 1200 F, and possibly to 1400 F.

In sheet form, the new alloy has been used in parts of jet engine and rocket-motor assemblies where stresses higher than can be imposed on standard Inconel are involved. Members designed to function as springs, including expansion bellows, have been cut or formed from sheet. Strip, down to light gages—0.006, 0.008, 0.010 in., etc.—is being used as spring material in valves of resonant jet engines.

Inconel X is available as a regularly produced mill product. Ingots weighing up to 7000 lb. have been cast from heats of about 9500 lb. The ingots are forged to round billets in sizes up to 12-in. dia. and weights up to 3000 lb. Billets for reforging are supplied rough machined; other forged and rough-machined disks and generally symmetrical shapes can

be made to order or drawing. Hot-rolled rods, with turned or ground finish, are produced in all sizes of rounds down to ½-in. dia. Some hot-rolled flats have been produced, but hot-rolled hexagons are not available. Cold-drawn rounds and hexagons in the smaller sizes and cold-drawn wire are also produced. Sheet and strip are made subject to limitations in gages and sizes. Seamless tubes are produced on order in sizes found to be practical.

Properties and Heat Treatment

Inconel X has a specific gravity of 8.3, magnetic permeability of 1.0028, and a melting range of 2540 to 2600 F. As would be expected, these values do not differ appreciably from those for standard Inconel. Coefficients of thermal expansion and moduli of elasticity over wide temperature ranges are shown in the accompanying tables. The high moduli indicate exceptional rigidity, and the low coefficients of expansion are valuable in minimizing stresses and changes in shape with varying temperatures. Impact strength values averaged from data based on two melts and two or three check tests at each point, and fatigue strength for specimens fully heat treated before testing, are also listed. Another table shows hardness ranges for Inconel X as affected by mill process and heat treatment.

The graph shows the principal static tensile properties of Inconel X up to the melting point for two different heat treatments. Curves indicating the 1000-hr. life of the alloy, creep strength in the fully heat treated condition, and fatigue strength are included.

Up to 1100 F, maximum strength is produced by direct aging without the solution treatment, whereas the triple heat treatment described later gives the best properties at temperatures above 1100 F. This conclusion can be verified by comparison of the 1000-hr. life curves for A (triple heat treatment) and B (hot-rolled and aged), which cross at about 1100 F. For all temperatures up to about 1000 F, the 1000-hr. rupture life is higher than the short-time yield strength when the curves for either the A or B heat treatment are compared. Below 1100 F, therefore, designing should be done on the basis of high temperature yield strength rather than rupture data. Because the rupture strength below 1100 F is so far above the high temperature yield strength, excessive elongation (5 to 10%) occurs upon loading to rupture stresses.

The curve of creep strength after heat treatment A is above the proportional limit in tension at all temperatures below the range 1175 to 1200 F. For this reason, creep is believed to be relatively unimportant in designing for temperatures below 1200 F. Creep resistance is of great importance in connection with the design of gas turbine blades, for the blade material must be able to sustain a load for a long period of time without change in length in the direction in which the stress is applied. Otherwise, change of shape under stress will result in interference of the blades with the enclosing structure. In a creep test on Inconel X,

Hardness Ranges as Affected by Mill Process, Heat Treatment

Mill Process and Heat Treatment	Air Cooled		Quenched	
	Brinell	Rockwell	Brinell	Rockwell
RODS AND FORGINGS				
As Rolled or Forged	228-298	20 C-32 C	140-277	77 B-29 C
Aged at 1300 F after Hot Working	313-400	34 C-44 C	Not applied	
Solution Treated	140-277	77 B-29 C	Not applied	
Aged at 1550 F after Solution Treatment	200-277	13 C-29 C	Not applied	
Aged at 1300 F after Aging at 1550 F	262-340	26 C-37 C	Not applied	
Stress Equalized at 1625 F	200-298	13 C-32 C	Not applied	
Aged at 1300 F after Stress Equalizing at 1625 F	302-363	32 C-90 C	Not applied	
SHEETS				
Annealed at 1900-2000 F				
Up to 0.125-In. Ga.	—	—	—	95 B
Over 0.125-In. Ga.	—	—	—	100 B
Aged at 1300 F after Annealing	285-336	30 C-37 C	Not applied	

Physical and Mechanical Properties

Temperature, F	Instantaneous Coefficient of Expansion (In. per In. per F × 10^6)	Modulus of Elasticity × 10^{-6}		Impact Strength (Ft.-Lb.)		Fatigue Strength (Psi.)	
		Tension	Torsion	Solution Treated, 2100 F, 2 Hr. Aged, 1550 F, 24 Hr. Aged, 1300 F, 20 Hr.	Hot Rolled, Aged 1300 F, 20 Hr.	10^6 Cycles	10^8 Cycles
−320	—	—	—	33	34	—	—
−109	—	—	—	36	37	—	—
80	—	31.0	11.0	—	—	—	—
400	8.0	—	—	42	44	—	—
800	8.4	—	—	50	46	—	—
1200	10.0	23.0	8.1	45	43	67,500	55,000
1350	11.4	21.0	—	49	49	54,000	49,500
1500	12.4	18.5	—	67	53	47,500	36,000
1600	12.8	—	—	113	82	—	—

Heat Treatment

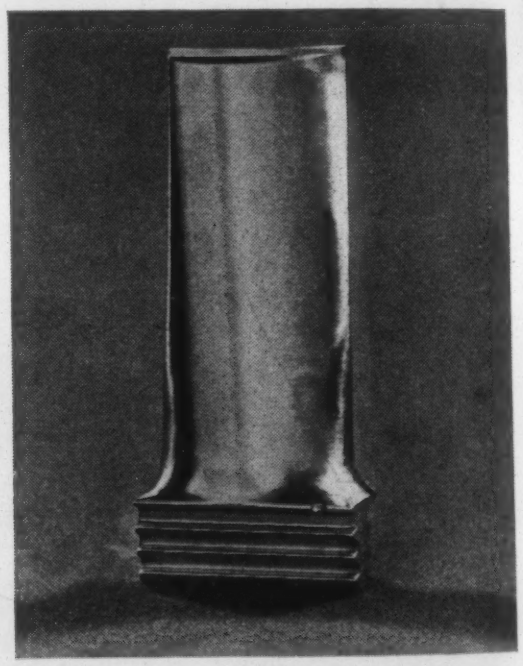
Material	Treatment	Step	Temperature, F	Time	Cooling
Bar Stock and Forgings	Full heat treatment	1.	2100	2-4 hr.	Air
		2a.	1550	24 hr.	Air (to room temp.)
		2b.	1550	24 hr.	Furnace (to 1300 F)
		3.	1300	20 hr.	Air
	Stress equalizing and aging	1a.	1625	24 hr.	Air (to room temp.)
		1b.	1625	24 hr.	Furnace (to 1300 F)
		2.	1300	20 hr.	Air
Sheets, Strip	Anneal	—	1900-2000	15-30 min.	Quench or fast air cool
	Age-harden	—	1300	20 hr.	Air
Wire	Anneal (use 40% cold reduction before re-anneal)	—	1900-2000	15-30 min.	Quench or fast air cool
Springs	Aging for low temperature use	—	1200	4 hr.	Air or furnace
	Aging for use above 650 F	1.	1350	16 hr.	Air
		2.	Maximum operating temperature +100 F (spring preloaded 10% above maximum operating stress)	1 hr.	Air
Spring Temper Strip	Aging for maximum room temperature properties	—	1200	2-4 hr.	Air
	Aging for maximum properties above 650 F	—	1350	16 hr.	Air

the extension caused by creep was 0.025% after 3000 hr. or about four months, not enough to cause interference in moving parts. Fracture occurred after another 4200 hr., or a total of almost 10 months. At that time the elongation had become 2.0%, an amount which would be in excess of clearances for a gas turbine blade.

The alloy can be brought into the solid solution state by heating at 2100 ±25 F for 2 to 4 hr. after the charge has reached uniform temperature, followed by air cooling. Moderate grain growth accompanies this treatment. Air cooling is rapid enough to produce optimum creep properties, and water or oil quenching is necessary only where softness is desirable for purposes of fabrication. The solution treatment is an essential first step toward development of maximum high-temperature strength and minimum creep rate.

The high-temperature aging treatment is carried on at 1500 ±25 F for 24 hr., and is followed by an air cool. This treatment is applied only to material that has been given a solution treatment at 2100 F and is always followed by low temperature aging at 1300 F. Grain size remains unchanged during the precipitation of the hardening constituents of the alloy. Hardness after the high-temperature age may be 200 to 277 Brinell.

Bellows of Inconel X such as these made by E. B. Badger & Sons are used for high temperature, high strength service in jet engines.

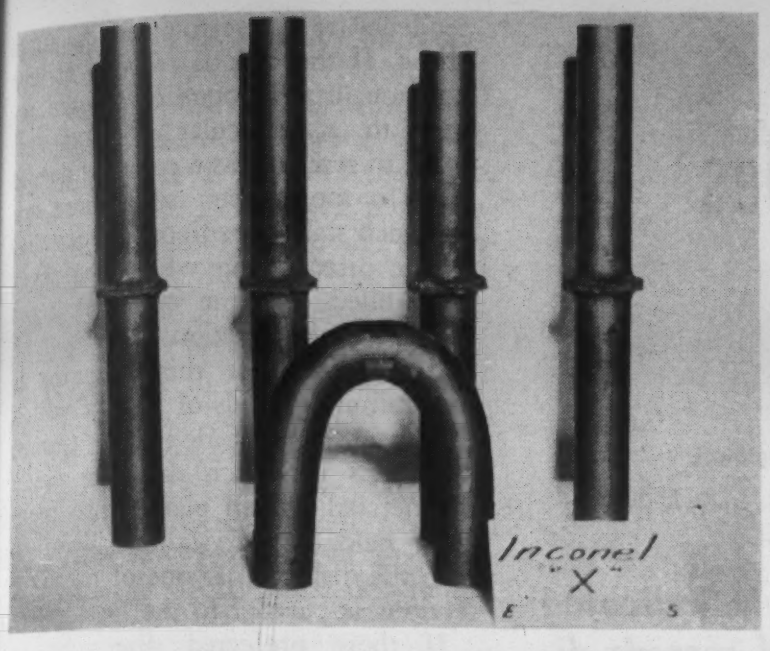


A small forged and machined gas turbine blade made by Pratt & Whitney for Westinghouse engine.

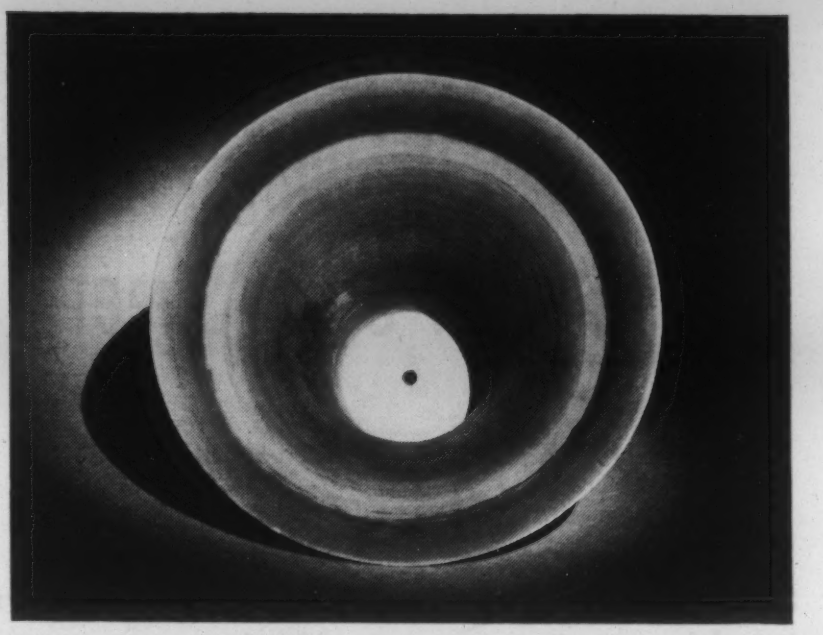
Final step in the complete heat treatment of Inconel X parts to be used above 1100 F is a low temperature aging treatment for 20 hr. at 1300 ±25 F, followed by air cooling. Coupled with the 1550 F aging, this treatment completes the precipitation of the hardening constituents and develops the best combination of rupture strength, creep strength and ductility for high temperature applications.

An annealing treatment, not effective in developing the best creep and stress-rupture strength, can be applied to facilitate further working of sheet metal and tubes. Annealing is accomplished by heating the material at 1900 to 2000 F for 15 to 30 min. and quenching, although air cooling may be rapid enough for thin sections.

The stress equalizing treatment specified for Inconel X consists of heating at 1625 ±25 F for 24 hr. It is applicable to forgings, billets,



Flash and butt welded Inconel X rod as-welded, and trimmed and bent to an angle of 180 deg. (Courtesy American Welding & Manufacturing Co.)



A sample of spun Inconel X.

rods, or machined parts that will later be aged and used under high stress at temperatures up to 1100 F. Grain growth is negligible. Stress equalizing is not recommended for components designed for use at 1200 to 1500 F, as full strength in this range can only be developed by the solution treatment.

Fabricating Properties

Compared with other high temperature alloys, Inconel X is considered to have good forging characteristics. Because of its high strength at high temperatures, however, equipment heavier than would be used for similar work on ordinary steels is required. Recommended forging range for the alloy is from 2225 F down to 1900 F or possibly 1800 F; the upper part of the range should be used for large forgings, and the lower part can be used for smaller sections.

Many heavy forgings, designed for use at ordinary temperatures up to 1100 F, can be stress equalized by charging hot into a furnace at 1650 F and holding. Favorable results for 700- to 900-lb. disk forgings have been obtained in this way. Hot working in the range 1200 to 1600 F below the recrystallization temperature should be avoided.

Although experience in production welding of Inconel is limited, the alloy can be joined by the metallic arc, inert gas-shielded arc, atomic hydrogen arc, resistance spot and seam, and resistance butt welding processes. Successful welds have been made between two parts of Inconel X and between one part of Inconel X and mating parts of other alloys, including standard Inconel, stainless types 310 and 347, and cast Stellite 21 and 30. The standard "132" Inconel electrode has been used in metallic arc welding to produce sound welds having good ductility.

Argon and helium gases have been used in the inert-gas-shielded arc process for acceptable welds joining 0.025- to 0.093-in. thick Inconel X sheets. This process requires a high purity welding grade gas. Helium is preferred slightly over argon as it provides a greater tolerance for non-uniform arc lengths.

The atomic hydrogen process works well on Inconel X of suitable thickness, 0.025 to 0.093 in. Because of the very high temperature of the atomic hydrogen arc, it is possible to overheat the surface of the puddle before the weld has had an opportunity to penetrate. On many jobs, consequently, the inert-gas-shielded arc is preferred over atomic hydrogen because of the much smaller heated area and subsequent distortion.

Inconel X has been successfully butt-welded to itself and to 4140 and 4340 steel sheets. High pressures and good power control during flashing and upset are essential to this process. Spot welding of Inconel X to itself has been done in several shops. Experience on spot or seam welding Inconel X to other materials has been largely unsatisfactory because of difficulties in obtaining a conventional nugget without excessive surface burning, porosity and expulsion. Additional development will be necessary before this type of weld can be used in production work.

Oxyacetylene welding of Inconel X also requires more development before it can be recommended. Because of the presence of the three worst oxides with which the welding industry must contend—chromium, aluminum and titanium—a very strong active flux must be used. Suitable fluxes are not now available for this process.

The strength and toughness of Inconel X makes it more difficult to machine than softer metals; it can, however, be machined at rates that are entirely practical. Whether a specific part should be machined from solution-treated, partially age-hardened, or fully age-hardened material depends upon the amount of stock to be removed, the finish desired, and other considerations which may arise in each case. Although rough machining can be done most easily in the hot-worked and solution-treated condition (140 to 277 Bhn.), the surface may tend to drag in this condition and the finish will not be smooth. Some shops machining parts where removal of stock is approximately ⅛ in. on the diameter prefer to machine partially or fully aged stock despite its reduced machinability and the resulting decrease in rate of metal removal.

A generous and continuous stream of cutting lubricant should be supplied to all machining operations. Soluble oils are recommended for cemented carbide tools. A lubricant of ten parts water and one part soluble oil, or nine parts water plus one part soluble oil and one part kerosene, has been used successfully, as have chemically active soluble lubricants such as Cimcool and Lusol. For high-speed steel and cast nonferrous cutting tools, sulfurized mineral oil and kerosene mixed to about 50-50 proportion is recommended as a good all-around cutting lubricant.

New Test Predicts Deep Drawing Properties of Steel Sheet

by **KENNETH ROSE**, Western Editor, Materials & Methods

Drawability of steel is quickly and accurately indicated by this new instrument, which measures and records directional properties of the material.

The torque magnetometer in operation. (All photos courtesy of U. S. Steel Corp. Subsidiaries)

● WITH THE PRESENT importance of deep drawing in the fabrication processes available for steel, reliable and practical methods of testing sheet to predict its drawability can be of great value to industry. Steel that tears in the presses, or that dog-ears, means losses in both the material itself and the labor put into it.

Various tests to predict drawability have been developed and used by pressed metal shops. Most of them are based upon the drawing properties of a sample disk of the steel sheet, as shown by actual drawing or cupping in a laboratory press. The results obtained have sometimes been difficult to correlate with shop results in which the working of the metal may be very different. Where a similarity existed, an empirical correlation of test results with shop practice has increased the value of the tests.

A test recently developed by Donald S. Miller, of the Research Laboratory of the United States Steel Corp. of Delaware, is based upon fundamental theory rather than upon performance. It is covered by patent applications, and several copies have already been put into service in the steel mills. The new instrument used in the test is known as a recording torque magnetometer.

Irregularity in stretching under the punch, when not caused by slag stringers or by surface defects discernible by visual inspection, is a result of a preferential orientation of the grain structure of the sheet. Engineers have frequently specified cross-rolled sheet for drawing stock to insure, as far as possible, a uniformity of grain alignment. Grain orientation also affects the magnetic properties of the steel, and it is in this way that the new testing device obtains a measure of this orientation, and, therefore, also of drawability.

Principles of Test

The principle of the instrument can be explained simply in terms of a common horseshoe magnet and a sample disk of steel. If the magnet is held legs upright and the disk rotated horizontally within the magnetic field between the two legs, the field affects the sample differently at various points of rotation. As the disk turns, it resists rotation in some positions, while in others it has a tendency to assist rotation or jump ahead. If the disk is released at any position, it will rotate of its own accord to a particular position and come to rest, just as a compass needle will. In most sheet steels there are two such stable positions, one parallel to the direction in which the sheet was rolled and the other at right angles to this direction.

The reason for this behavior is that minute crystals of iron of which the sheet is composed have certain directions in which they are easily magnetized. When placed in a magnetic field, the crystallites want to turn the disk so that one of these directions is parallel to the field.

If these preferred directions in the crystallites were uniformly distributed in all directions, they would compete with each other, and there would be no torque on the disk. But in almost all kinds of sheet steel these preferred directions are more or less concentrated about certain directions in the sheet. As a result, some of the crystallites cooperate to rotate the disk in the magnetic field. The greater these concentrations the greater will be the resulting torque.

Instrument Described

The instrument itself is quite simple. It consists of two strong electromagnetic coils mounted horizontally end to end with a short gap between them. The specimen disk is placed horizontally between the coils and rotated. As the disk rotates, the magnetic field affects the rotation, depending on the magnetic directional properties in the specimen. Beneath the sample and attached to its mount is a strain gage, which measures this effect at various points of rotation. The measurements are translated automatically by a moving pen from the gage to the chart paper of a recorder.

For the present test, the specimen is placed between the electromagnetic coils in an air gap of about 1¾ in., and a magnetizing current of about 2½ amp. at 120 v. is applied to the magnet. The specimen is rotated by a synchronous motor that is correlated to the motor drive of the strip chart, the speeds of chart and specimen bearing an exact relationship to each other. Oriented steels will show a variation in the response to the magnetic field; at some positions there will be a slight retarding force, at others a slight accelerating force to the torque applied by the motor turning the specimen. This is

converted into a voltage by the strain gage, and the voltage is recorded on the moving chart. The chart then contains a record of torque plotted against angular position of the steel. About 6 min. is required to rotate the sample through 180 deg., but at the end of that time the test is complete, with a graphic record available for study or later reference.

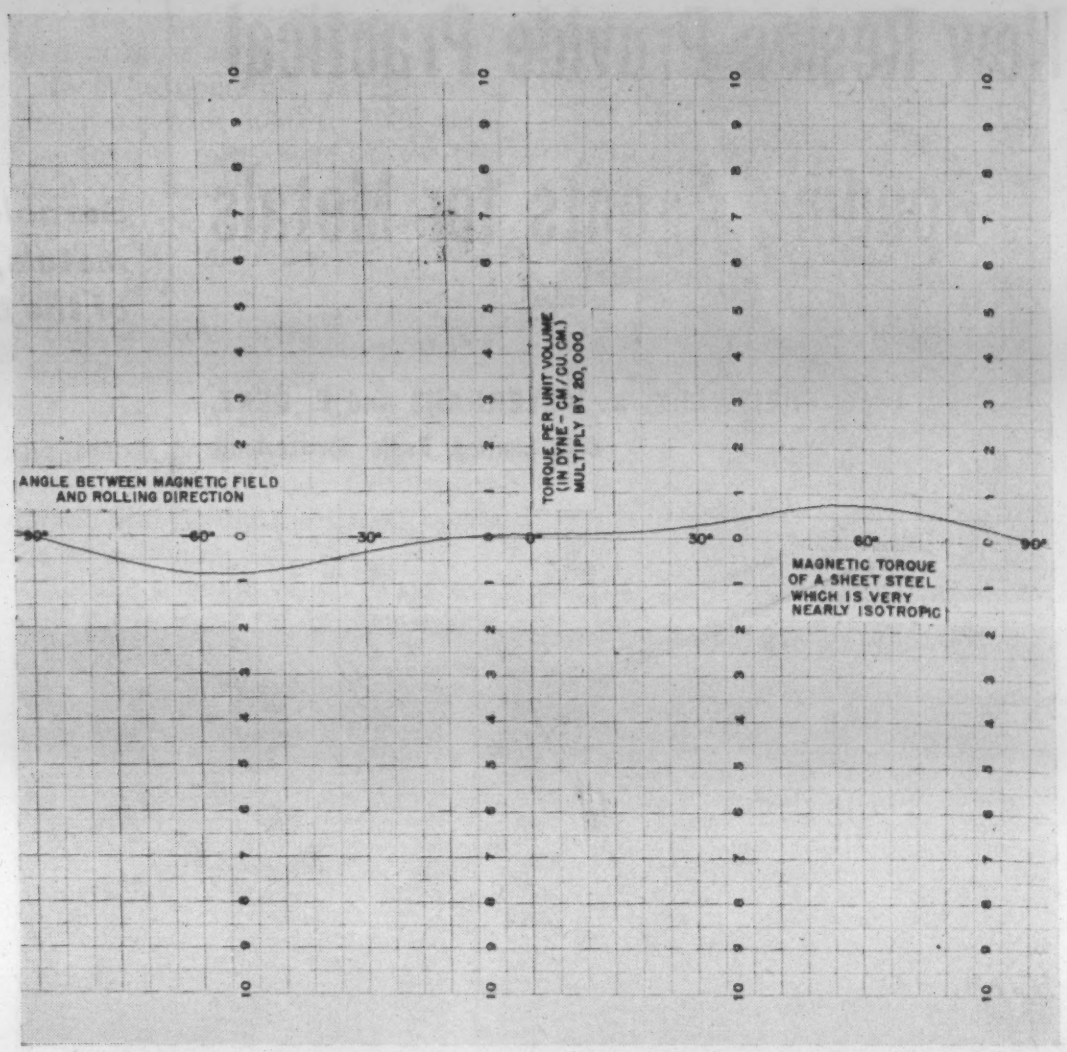
The factor for converting torque to voltage can be varied in a ratio of 5 to 1 by varying the current input to the bridge circuit of the gage. This gives the instrument a wide range in use, with the possibility of sharpening accuracy when results are low on the scale.

The disk specimens used with the present instruments are 1 in. in dia. and from 0.010 to 0.100 in. thick, cut from the drawing stock, or, at the mill, from rolled sheet. Modification of disk design is easily possible where specimens of other size could be tested to advantage. Tinplate is one such case. As the total torque is proportional to the volume of the specimen, and tinplate is both thin in cross section and of low torque per unit volume, a specimen of larger diameter would give greater sensitivity to the test.

Other testing devices making use of magnetic properties to determine grain orientation have been built and used during the past 20 years, but all have been so complicated in operation and in interpretation of results that their value has been limited. Curves formerly plotted by hand from tabulated test data, and requiring about an hour for their completion and interpretation, are drawn by the recorder in the new apparatus, and a rough idea of the grain orientation may be obtained at a glance.

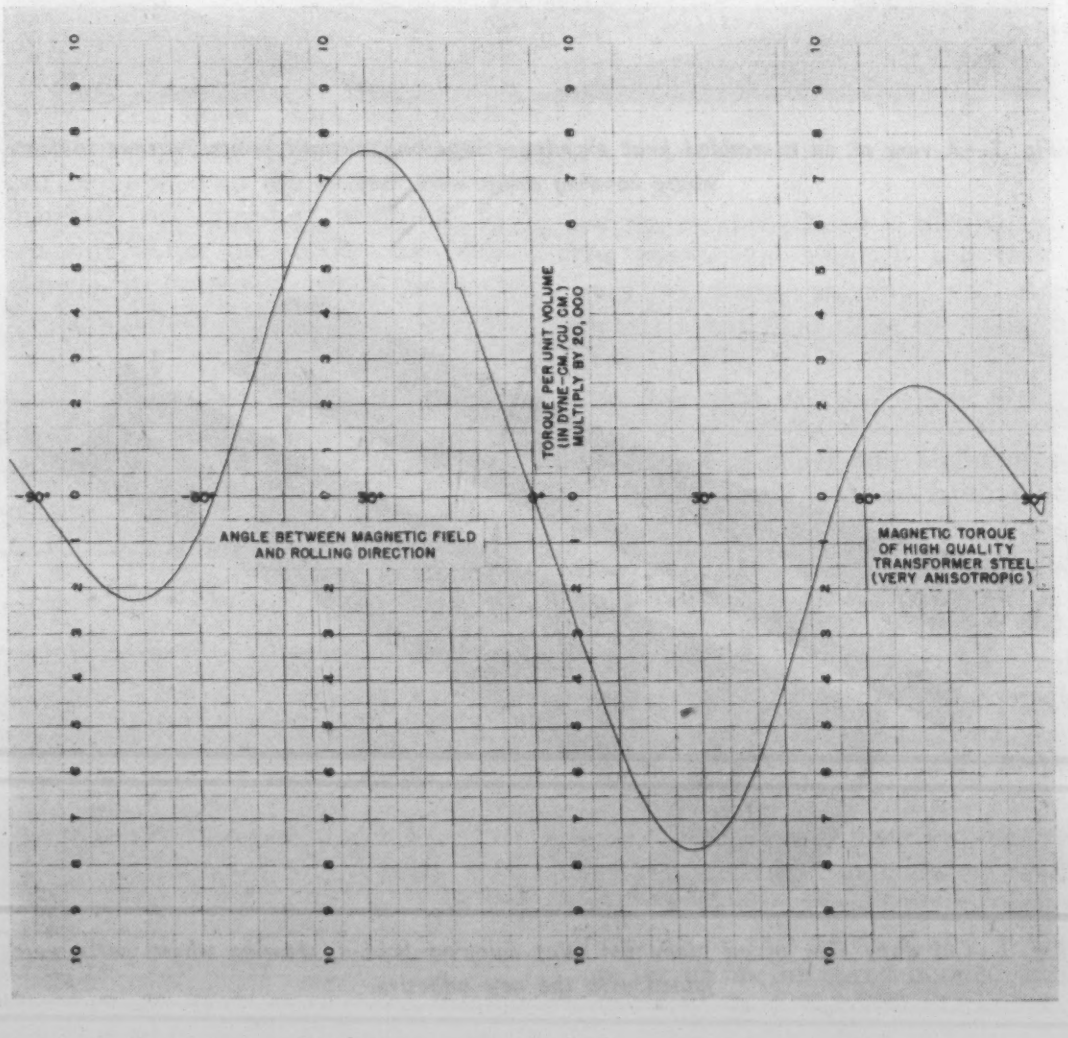
While emphasis has been given to the use of the device for measuring unwanted directional properties in steel, it is equally useful for determining the degree of orientation obtained in such specialty steels as high silicon steel for transformer cores. Here it is desirable to have a steel as strongly directional as possible, and the new testing instrument has found ready acceptance for measuring this property at the mill. It is economical both in time and in material used for testing.

Torque magnetometers are now in practical use at the Carnegie-Illinois Steel Corp.'s sheet and tinplate mill at Gary, Ind., and at the same company's silicon steel mill at Vandergrift, Pa., as well as in the research laboratory at Kearny, N. J.


ANGLE BETWEEN MAGNETIC FIELD AND ROLLING DIRECTION
TORQUE PER UNIT VOLUME (IN DYNE-CM/CU. CM.) MULTIPLY BY 20,000
MAGNETIC TORQUE OF A SHEET STEEL WHICH IS VERY NEARLY ISOTROPIC

Record of the directional properties of a plain carbon steel for press forming.

A transformer steel, highly directional in magnetic properties, gives this curve in the torque magnetometer.


TORQUE PER UNIT VOLUME (IN DYNE-CM./CU. CM.) MULTIPLY BY 20,000
ANGLE BETWEEN MAGNETIC FIELD AND ROLLING DIRECTION
MAGNETIC TORQUE OF HIGH QUALITY TRANSFORMER STEEL (VERY ANISOTROPIC)

New Resins Provide Practical Bonding Agents for Metals

Durable, high-strength bonds joining metals, nonmetals and combinations of the two are possible by use of these new adhesives.

by E. PREISWERK, K. MEYERHANS and E. DENZ,
Ciba Limited, Basle, Switzerland

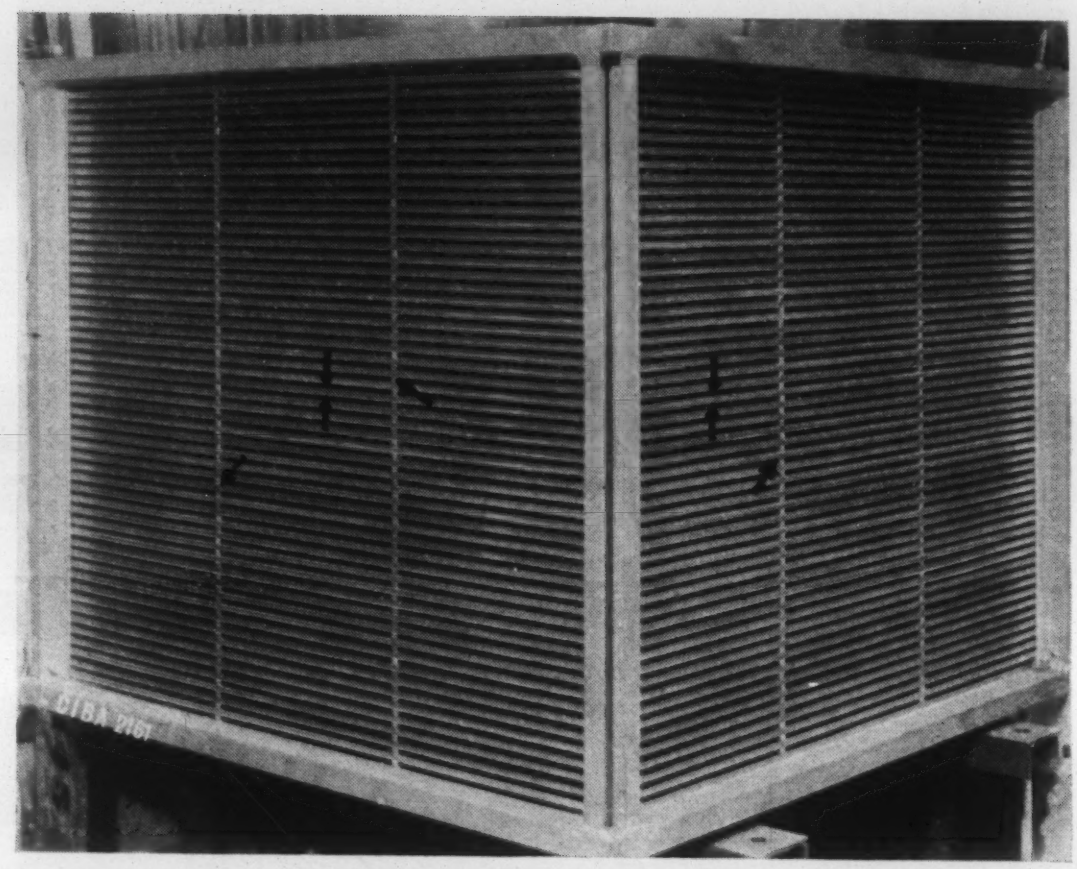


Fig. 1—A view of an assembled heat exchanger requiring airtight joints. Arrows indicate where bonding resins were used.

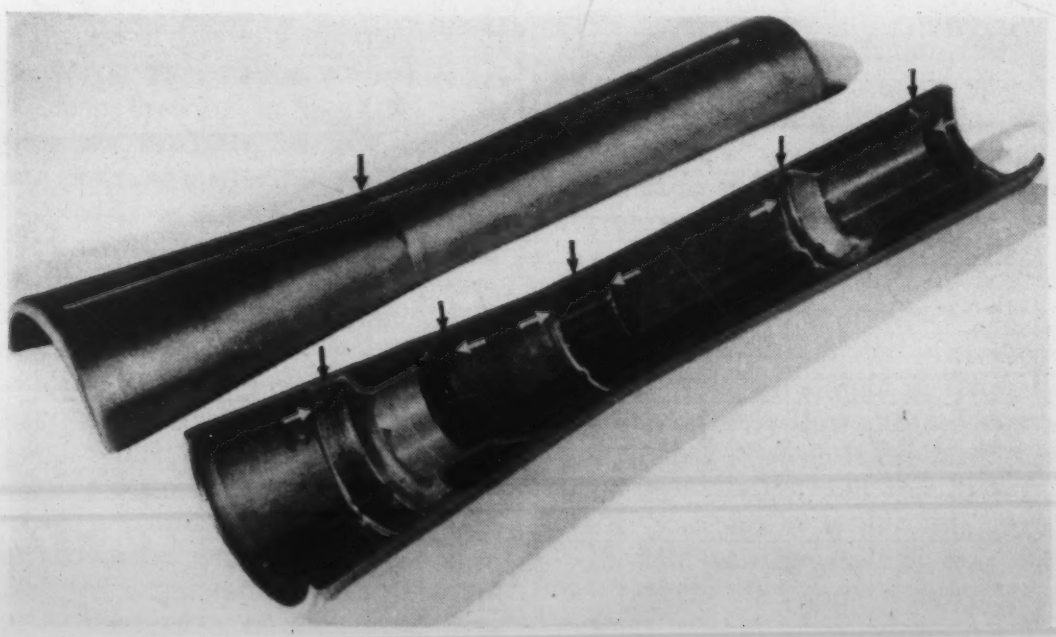


Fig. 2—Cut away view of an aluminum alloy spinning bobbin, showing where parts were joined with the new adhesive.

● INDUSTRIAL RESIN BONDING of light metals, metals and ceramics, glass and plastics now appears more practical as a result of the development of the new ethoxyline resins supplied under the name "Araldite." Ethoxyline is the name given to a new class of resins in which aliphatic-aromatic chain molecules have at their ends a reactive ethylene oxide group. These resins, which are cured either at elevated temperatures or at room temperature without splitting off volatile substances, exhibit great adhesion to almost all materials, high mechanical strength, and good durability.

This new development is particularly significant in the field of light metals, as the processes of welding, riveting and soldering light metals are not always satisfactory. Some of the industrial uses of Araldite are illustrated in the accompanying photographs.

Previous to the development of the ethoxyline resins, it was impossible to bond many materials for want of a suitable bonding agent or because the bonding process was too complicated and, therefore, uneconomical. In early resins the products liberated during the curing process were not absorbed by materials such as metals, glass, etc., which are impervious to volatile substances, and this prevented the formation of a homogeneous firmly adhering bond. Many resins which partially overcame these disadvantages were developed, but pressure and heat were required for bonding and laminating the materials, making the use of hot presses indispensable. An additional restriction was the fact that certain binding processes, *e.g.* tubes, cannot be carried out under pressure.

The problem was to develop a resin with sufficient adhesion to metals and other materials, together with high mechanical strength, which

could be cured without splitting off volatile substances. Araldite appears to be a successful solution to this problem.

Characteristics and Properties

Araldite is supplied in various forms, such as powder, soldering rods, and as fluids. Selection of the proper form is determined by the strength of the parts to be bonded, kind of materials to be used, and the manufacturing conditions.

Although room temperature suffices in certain cases, curing is usually carried out at elevated temperatures. In the range of the hot-curing ethoxyline resins, a type has been developed that exhibits outstanding mechanical strength and specific adhesion. Araldite Type 1, supplied as rods and powder, is a mixture of resin and hardener which is solid at room temperature, begins to soften at 160 to 175 F, and is free-flowing at 250 to 285 F. At this temperature it penetrates by capillary action into the smallest gaps.

Because there is no solvent present, "precuring" is not necessary. The final bond is produced by subsequent curing for periods ranging from 20 min. to 14 hr. at temperatures between 390 and 265 F. Fully cured, the resin is non-toxic, odorless and tasteless. A metallic or colored appearance can be given by incorporating metallic powders or dyestuffs. The resin, a highly polymerized neutral substance, has no corrosive effect on the metals. The mechanical strengths of Araldite Type 1 bonds are shown in the accompanying table.

When curing was carried out for longer periods (24 to 48 hr.) at about 340 F, further hardening took place. Shear strengths at 250 F were about 70% of those at 68 F. Further curing for eight days at 250 F gave shear strengths at 300 F only about 40% of those at 68 F.

Room temperature fatigue tests, carried out with 4000 to 5000 stress reversals per min., have shown that when the relation of length overlapping to the thickness of the sheet metal is ⅓, the following relationship holds:

$$\frac{\text{Fatigue Shear Strength}}{\text{Static Shear Strength}} = 0.33$$

This relation is the same for single and double overlapping bonds. Under dynamic flexural load, fracture occurred first in the metal and not in the resin bond.

Tensile strength of the bond used with Anticorodal (aluminum-magnesium-manganese-silicon) and cured 1 hr. at 390 F ranges from 8660 to 13,200 psi.

Water resistance tests have indicated a strength loss of about 10% for 30 days, at 68 F and a loss of 37% for 30 days at 195 F. No change in strength was observed after a 30-day immersion at 68 F in aircraft engine fuel oil. At room temperature, a slight loss of strength apparently occurs after long periods of time. Loss in strength after two years' exposure to rain, sunshine, wind and frost in an industrial atmosphere containing a large proportion of sulfur dioxide amounted to about 50%. Although the surface of Anticorodal sheets were strongly attacked by atmospheric influences, no appreciable corrosion was observed at the points of contact between resin and metal.

Ethoxyline resins have been developed in liquid and cold-setting forms. The liquid resin and hardener are supplied already mixed and can be applied to the surface of the material by dipping, brushing or spraying. After the solvent has been allowed to evaporate, the surfaces to be bonded are brought into contact and the resulting bond is then cured. The mechanical strength and resistance to water, solvents, etc., are slightly lower than those of Araldite Type 1.

It has been found possible to cement wood and metal at normal temperatures and under only slight pressures, the resulting bond having no corrosive effect and demonstrating good resistance to water. Cold-setting bond strengths average ⅓ to ½ and more of those obtainable with Type 1. This process is of practical importance for furniture, carriage bodies and aircraft construction.

There are other methods for bonding wood and metal with good resistance to water, but they require hot presses, which are not always available. A further disadvantage of hot pressing is that stresses and strains are set up in the cured bonded parts

Fig. 3—An arrow points to bond between body and bottom of cigarette lighter cemented with Araldite 1 powder.

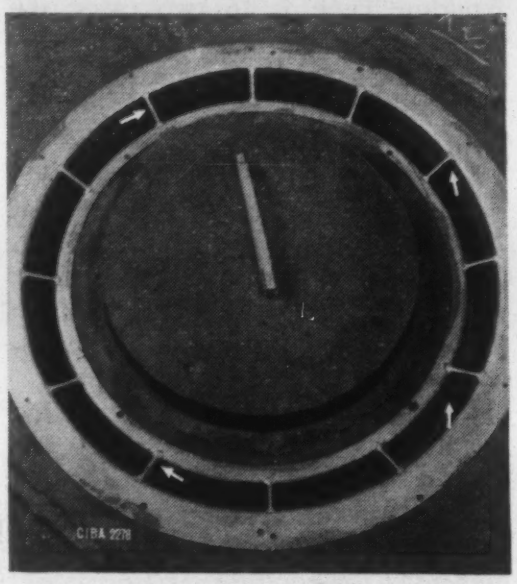


Fig. 4—Master mold made of cast light metal, in which partitions are bonded to the walls with the adhesive.

Araldite Type I Bond Strengths

Metal	Temperature, F	Strength (Psi.)	
		Shear	Yield
Aluminum Alloy (Anticorodal Al-Mg-Mn-Si)	—76	10,670	—
	—4	9230	—
	68	8110	42,200
	140	6120	—
	212	4160	—
Iron	68	6950	34,300
Chromium-Nickel Steel	68	7690	43,400
Copper	68	7050	36,300
Phosphor Bronze	68	7610	88,600
Brass	68	6580	38,700

NOTE: Static load; double overlapping; length of overlapping, 0.2 in.; cured 1 hr. at 390 F; metal surface roughly polished, degreased; pressure less than 710 psi.

as the result of differences in the thermal coefficient of expansion of the different materials in the bond.

In preparation for the cold-setting bonding process, a coating of resin is baked at 300 to 390 F on the metal surface, a simple and short operation best carried out by the metal manufacturer. Prepared in this way, the metal can be bonded with wood or similar materials by means of ethoxyline resins at room temperature and only slight pressure.

Many hitherto insoluble problems in the field of metal bonding can be solved in new and economical ways with the help of ethoxyline resins. The following examples have been selected to illustrate the kind of problem likely to arise in the workshop, factory or mass production line. In all cases, the bonding resin used was Araldite Type 1. In two cases, the resin was applied as sticks; in the other case a powder was used.

Light Metal Heat Exchanger

The problem was to bond a great number of parts into a single compact structure having airtight joints. A view of the assembled heat exchanger is shown in Fig. 1. The problem was solved in 19 steps.

The first step, protection of the metal parts from corrosion, was accomplished by spraying them with Araldite surface coating resin 985 E and precuring. Araldite Type 1 was then used for bonding. The final curing of the surface coating resin was completed during the period in which the bonding resin was cured. The mechanical strength of the coated metal after curing was found to be practically equal to that of the untreated bonded metal.

Spinning Bobbin

The chief problem was to bond the drawn parts to a rotating outer case (see Fig. 2). The material to be bonded was an aluminum alloy. It was essential that the outer surface of the bobbin be perfectly smooth, and a high degree of exactitude in rotation was specified. (The bobbin had to make 6000 to 10,000 rpm. with a maximum permissible deviation of 0.008 in.) Consequently, it was impossible to bond the parts by soldering, welding or riveting.

The problem was solved in 19 steps. Advantages of the bonding method included (1) use of unskilled labor, and (2) use of few and simple tools. Hot presses were not necessary and a simple oven sufficed for curing.

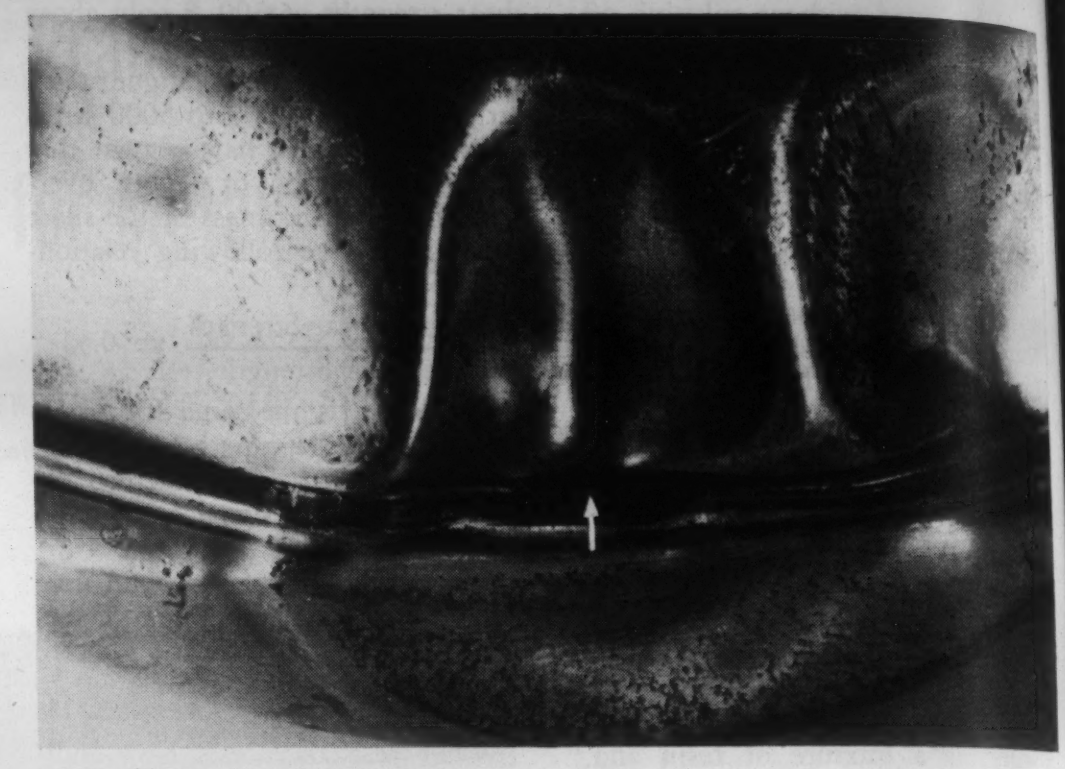


Fig. 5—The joints in this light metal container were bonded with the new resin and remained intact after rough treatment.

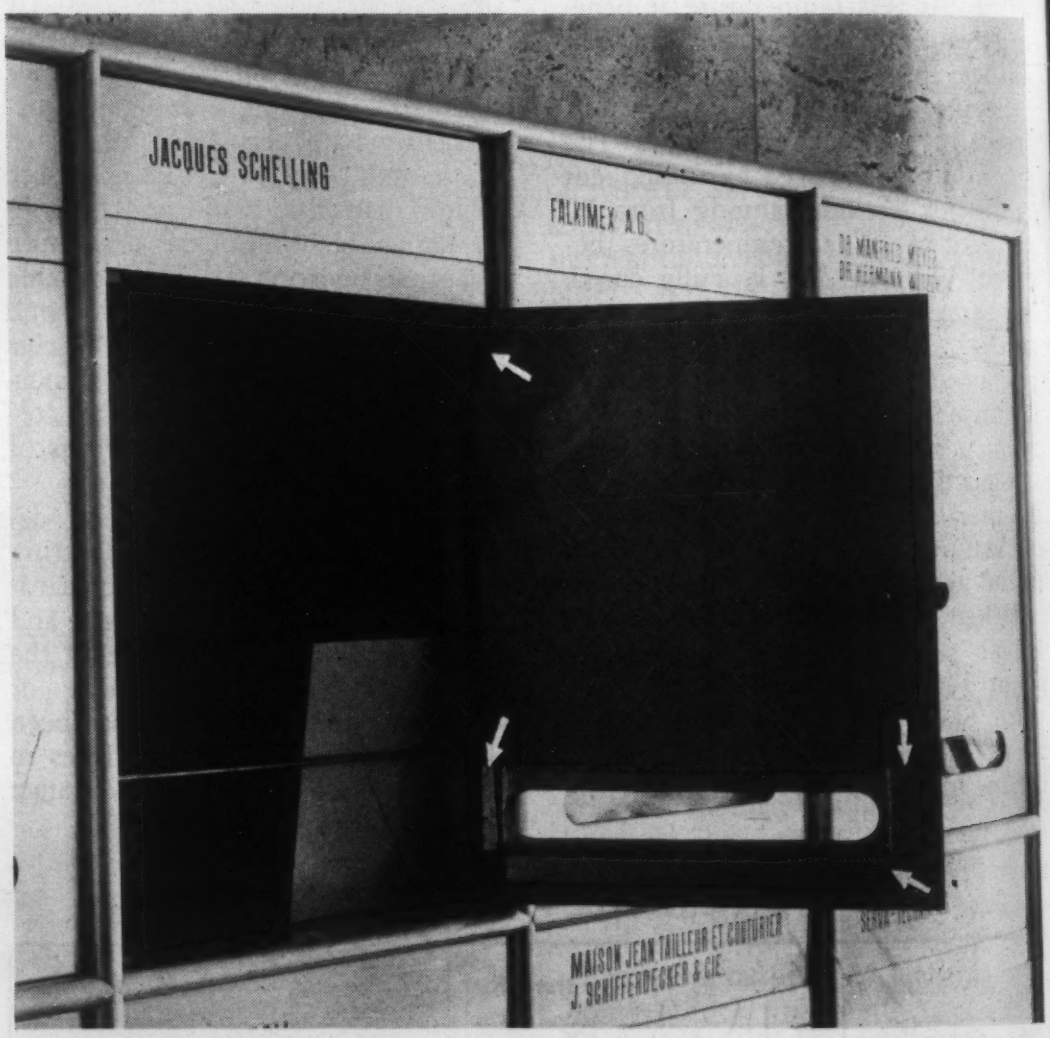


Fig. 6—Box door of light metal in which hinges, slot frames, etc. are bonded with the new adhesives.

Cigarette Lighter

The problem was to supply the hollow profile section for the tank with a solid top and bottom consisting of solid profile sections. A view of the assembled lighter is shown in Fig. 3.

The problem was solved in two steps by cementing the metal parts with an oil-resistant bond of Araldite Type 1 powder. This process can be carried out automatically. In connection with this application, it was found that aluminum pieces bonded with Araldite Type 1 can be anodically oxidized without damage to the resin bond.

Prefinishing of Steel for Plating or Enamelling Cuts Production Costs

by KENNETH ROSE,
Western Editor, Materials & Methods

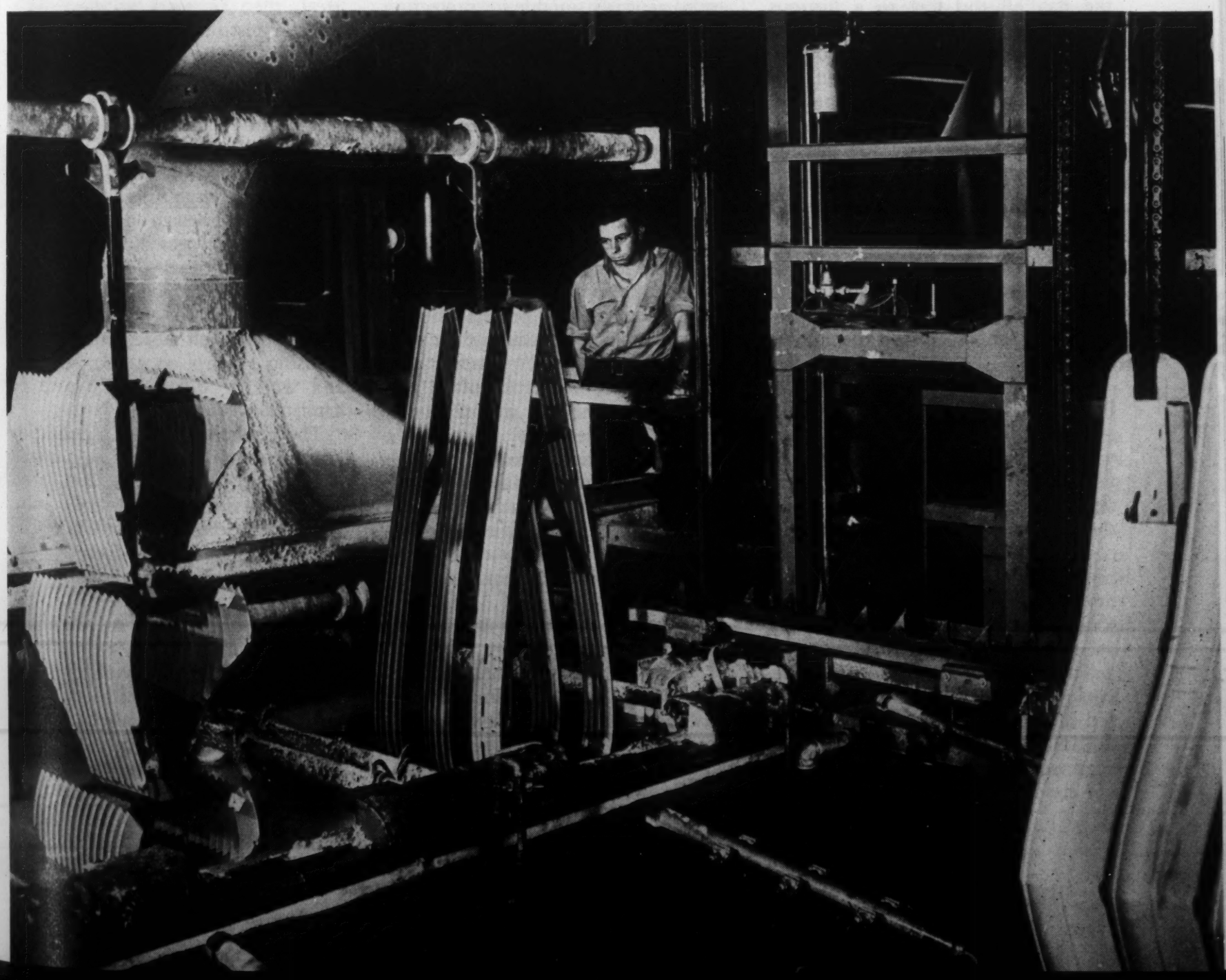
Buffing and polishing steel in the flat and protecting the surface during forming with a special coating is an attractive cost-saving method for preparing irregular shapes for final finishing.

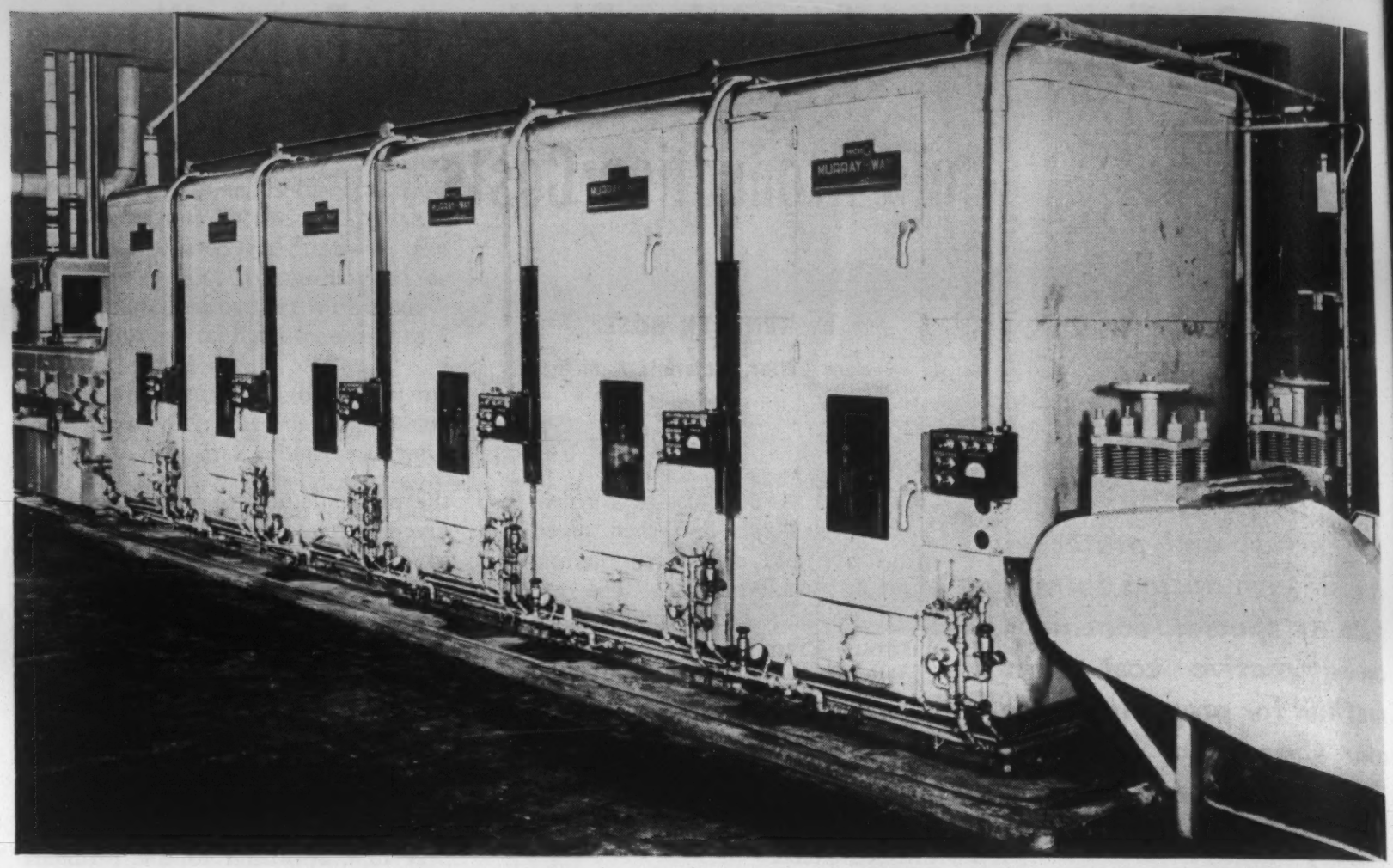
● WHEN STEEL must be formed to a finished shape, and then given a protective and decorative plating, a difficult problem arises. The metal must be buffed and polished to a lustrous, scratch-free surface, for any defect in the base metal will appear in the plated surface. Polishing of an irregular shape to the high finish desired is a difficult and costly matter, and polishing costs can easily be the largest item in the cost of the finished piece.

Enamelled pieces do not require the same degree of attention as is given parts to be plated and buffed to a mirror finish. However, even with pieces to be coated with vitreous enamel, the surface must be free of defects, and when present in the formed piece, they must be worked out by hand. Orange peel is one of the most troublesome of the surface defects on steel used for enamelling. Here, too, the hand operations are costly and time-consuming.

A new approach to the problem is the prefinishing of carbon steel in

When not prefinished, automobile bumpers require a series of difficult grinding and buffing operations using formed wheels prior to plating.





A typical prefinishing installation. (Courtesy Murray Way Co.)

the flat, all the way to a lustrous finish ready for plating, and to coat this polished steel with a removable protective coating. The prefinished steel is then cold-formed in presses, the protective coating is removed, and the steel is ready for plating. The ease with which the steel is finished in the flat, compared to the difficulty of taking a curved and irregular surface to a high polish, represents a substantial saving. With the proper protective coating the steel emerges from the forming operations unmarred, and no touchup is required.

The protective coatings that can be used include: (1) solvent type strippable lacquers that generally involve a formulation of one of the vinyls; (2) strippable water dispersions of compounded plasticized synthetic resins; or (3) water-soluble coatings. The strippable coatings can be applied by spraying, dipping, brushing, or by roller methods. The water-soluble coating can be brushed on, sprayed, or dipped.

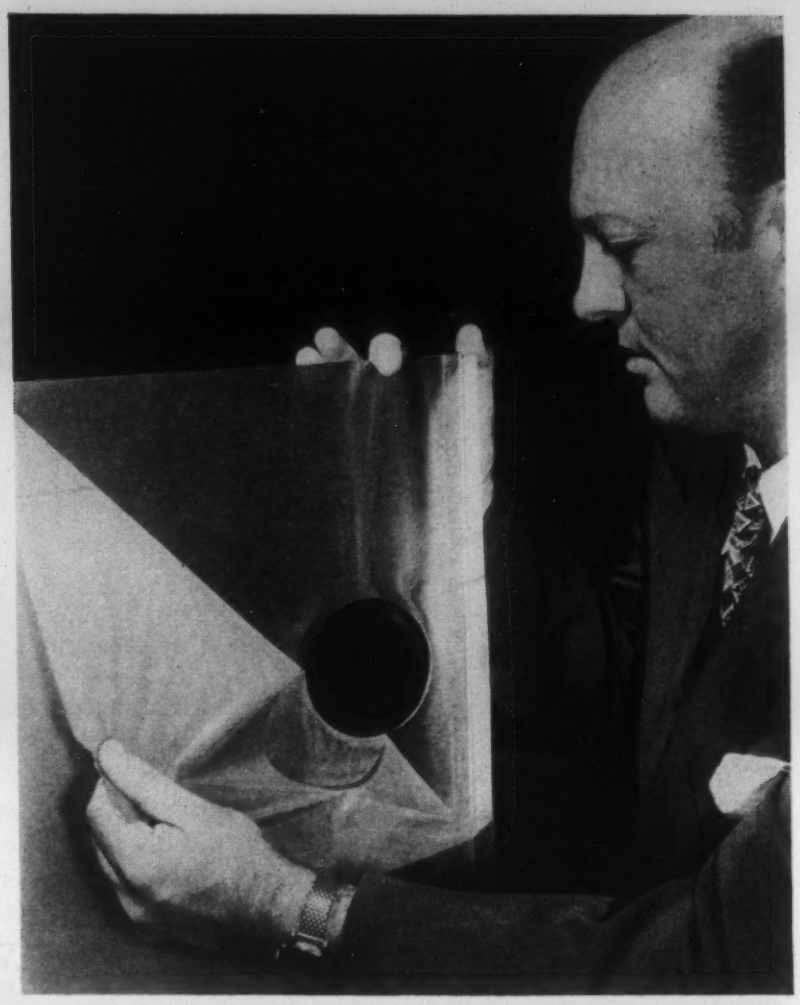
These protective coatings can be used on practically all finished metals and alloys. Because of their ease of application by spraying as well as their relatively high film strength and elasticity, the strippable coatings are particularly suitable for protecting prefinished surfaces during fabricating and handling operations. Polished sheets of metals, such as stainless steel, Monel, brass, aluminum and magnesium, can be coated as far back in the production line as the metal producer's warehouse if necessary. As mentioned previously, in metal forming shops these protective films prevent scratching and blemishing of the prefinished metal surfaces during pressing, cupping or drawing. They can also be used to protect finished surfaces during machining, cutting and sawing, and welding operations. For example, some hospital and kitchen equipment manufacturers spray the stainless steel sheet with a protective coating before forming, and do not strip it off until after the shapes have been punched, welded and assembled into finished units. In some of the forming operations presses up to 16,000 tons capacity are used.

Prefinishing Automobile Bumpers

A large-scale application of prefinishing that has shown marked success is the production of automobile bumpers. Heretofore it has been necessary to form the bumper from strip steel, then to work it down to a smooth, lustrous finish for chromium plating. The grinding and polishing had been done in a series of grinders with formed wheels, ending with a final buffing of the steel surface. The previous set-up of the series of machines to rough-grind, finish-grind, and buff the rough steel required considerable floor space, and the maintenance of the formed wheels themselves has been costly. Where the volume of work did not justify a grinding line, the work has been done by the even more costly method of using a wheel on a pivoted lever, and working down the surface by hand.

The method now being employed in several of the large automobile plants, and in the Standard Steel Spring & Bumper Co., Coraopolis, Pa., and the Electric Auto Lite Co., Sharonville, Ohio, involves the use of a series of three to six belt grinders, which successively rough-grind, fine-grind, and polish the flat steel to the finish desired for plating. Immediately after the polishing the steel is coated with a protective material. This protects against marks during handling, or corrosion of the surface during the interim between operations, and against marring of the

By use of strippable coatings, metal surfaces can be protected during forming operations.



The protective coating can be readily peeled off after forming the steel. (Courtesy Eronel Services)

surface during the press-forming of the metal.

After the metal has been formed, the protective film is removed with an airblast in the case of the strippable lacquer, or with water jets or a dip tank in the case of the water-soluble coating. The steel is then started through the plating tanks.

Steel grilles that are to be plated are also now being made by prefinishing the steel. Savings here are similar to those realized in the bumper development.

Advantages of Prefinishing

Some of the advantages of prefinishing steel as they have been brought out in these installations are:

(1) Unit cost of the piece is lowered. There is a direct saving per unit in addition to the corollary savings.

(2) Die life is lengthened.

(3) Rejects are reduced.

(4) The finished plate has a better appearance.

(5) Plant capacity is increased without increasing costs.

While the present going installations of prefinishing equipment have to do with steel, and are largely in the automotive industry, the production of refrigerators, domestic ranges and similar home appliances, copper, bronze and silver products, including jewelry and tableware, are other possibilities.

Several developments by the Minnesota Mining & Manufacturing Co., St. Paul, add considerably to the advantages of the prefinishing technique. One of these is a new type of belt in which a synthetic resin is used to bond the mineral grain to the belt; another is a new type of back-up wheel which supports the belt at the point of grinding contact with metal and which permits belt speeds of 10,000 surface feet per minute for the first time. While not directly related to prefinishing, another development involves a new type of back-up roll, with a contoured face for grinding and polishing all contours of an irregular-shaped piece in a single operation.

Used with a specially-developed machine, the contoured back-up wheel has increased production for Balcrank, Inc. of Cincinnati from 125 crank handles per man-hour to 500. The machine incorporates a revolving jig that holds crank handles during polishing. The high-speed type of back-up wheel is especially designed for removing a lot of metal stock in a single belt grinding operation. At R. C. Hitchcock & Sons, Inc., Minneapolis, it resulted in boosting production 150% on the grinding and polishing of aluminum castings. At the Standard Conveyor Co., North St. Paul, Minn., the production rate was doubled on the grinding off of 16-in. long welds from carbon steel rollers for conveyor systems.

The new type of belt, combined with the high-speed type of back-up wheel, has been used by the Kropp Forge Co., of Chicago, one of the world's largest job forging shops, to cut its grinding costs in half. Production was boosted from 40 to 60 forgings per man-hour on the removal of flashings from forgings of heat-hardened high carbon steel. The belt is designed for jobs that involve unusual drag or abuse of the belt, and on such jobs, the new belt is said to last more than twice as long as previous belts.

There are many possibilities for making significant savings in grinding and polishing operations through prefinishing and adoption of other new grinding developments. So the engineer would do well to consider whether these developments could be adapted to his own plant production.

Furnace Brazing Successfully Used on Aluminum Assemblies

By use of proper techniques and brazing alloys the difficulties of joining aluminum were overcome in fabricating refrigerator liners.

by A. L. GOLDSMITH and C. E. HICKMAN, The Brazeway Co.

● ALUMINUM ALLOYS, with many favorable features in the way of light weight, adequate strength, and ease of fabrication, are difficult to join by soldering or brazing. The thin oxide film that provides corrosion resistance also serves as a barrier to the easy wetting of the metal by the fused bonding materials. Fluxes containing fluorides will dissolve the film of alumina, but they are corrosive and poisonous, and must be used with more caution than is required with the handling of most of the fluxes available for use with the lead-base solders or the silver solders.

The excellent properties of aluminum have caused its use to expand rapidly in spite of these minor handicaps, however, and it has gone into applications where its brazing, while somewhat more difficult than the procedures for steel or copper, is an everyday practice.

Clad Brazing Sheet

The use of the clad sheet announced several years ago by the Aluminum Co. of America, in which one or both faces of the metal are coated with the brazing alloy, has stimulated the furnace brazing of parts where preplaced brazing alloy could not be adapted effectively. This sheet is produced by rolling a thin layer of brazing alloy on one or both sides of the base aluminum alloy. Products can be made from this material by any of the common forming methods and brazed without the addition of any other filler material. When parts assembled of this ma-

Aluminum assemblies are usually brazed in batch type electric furnaces. (Courtesy Aluminum Co. of America)

terial are raised to the brazing temperature, the layer of brazing alloy melts and flows into the openings at the joints and seams. The advantages are obvious. No preplacement of brazing filler material is required and the problem of metal flow is largely taken care of, because the brazing alloy is already present on all joining surfaces.

The sheet is available in three combinations of alloy and coating. The various types are listed below.

Nos. 21 and 22 have a heat treatable aluminum alloy core, while all the others have a core of 3S, which is nonheat treatable. Therefore, if directly quenched after brazing or if given a subsequent heat treatment, Nos. 21 and 22 will give higher mechanical properties than the others.

The coating on Nos. 1 and 2 makes them most suitable for uses where a light-colored part is required. The coating on Nos. 11 and 12 and Nos. 21 and 22 have a lower melting range, for use where a lower brazing temperature is desirable.

As aluminum itself melts at a temperature below a red heat, the brazing alloys, themselves aluminum compounds, are designed to fuse at temperatures much closer to the softening point of the base metal than is the case with silver or copper brazing. The brazing alloys are formulated to possess a high degree of fluidity at a temperature slightly below the softening point of the base alloy, so that careful control of furnace temperatures is necessary.

Aluminum tubing is brazed to the flat sheet before being formed into the box shape shown here. (Courtesy Brazeway Co.)

Brazing Refrigerator Liners

A field in which the excellent thermal conductivity and high corrosion resistance of aluminum give it advantages over most other commercial metals is refrigeration. Several manufacturers of the standard home refrigerators and freezers, as well as certain types of commercial cabinets, have found that cooling coils and liners of aluminum tube and sheet afford a rate of heat transfer comparable to that of copper tubing and steel sheet, with practical elimination of the corrosion problem. Weight saving is an important economy.

To insure proper heat transfer from the interior of the refrigerator to the coils containing the refrigerant, the coils are brazed to the aluminum sheet that forms the liner for the refrigerator. The volume of work produced by this method daily, and the quality of the work so produced, testifies to the success of furnace brazing of aluminum.

One of the important users of brazing methods for aluminum is the Brazeway Co., of Adrian, Mich. The procedures described are those in use by that company.

The liners for refrigerators, one of the high-production lines of the company, are made in the flat and bent to box shape after the tubing has been brazed to the sheet. Aluminum tubing is bent to the desired pattern over a fixture in the usual manner. The sheet stock most used is Alcoa's No. 11 brazing sheet, having a base of 3S alloy and 10% of cladding with brazing alloy on one side. The sheet has the following composition:

Base metal—1.2% manganese, balance aluminum.

Cladding—7.5% silicon, balance aluminum.

The cladding is thinner than 10% of total thickness in heavy sheets. The sheet is also available in types clad on both sides when the work requires such a material. The tubing is of 2S or 3S alloy.

The sheet is notched and flanged to facilitate later bending, and is then fluxed preparatory to brazing. Because of the size and shape of the flat

Types of Brazing Sheets

Designation	Sides Coated	Coating Thickness
No. 1	1 side	10% up to 0.020 in.
No. 2	2 sides	5% over 0.020 in.
No. 11	1 side	10% up to 0.063 in.
No. 12	2 sides	5% over 0.063 in.
No. 21	1 side	10% up to 0.093 in.
No. 22	2 sides	5% over 0.093 in.

piece, the flux is applied by brushing. Several fluxes are available for use in aluminum brazing, all having a fluoride base, and all expensive for job shop use. To keep costs to a minimum while insuring satisfactory work, a mixture of three standard fluxes is used. These are:

No. 30—higher melting point (about 1110 F)

No. 33—lower melting point, active chemicals (1100 F and up)

No. 34—low cost, and diluent for more costly fluxes (1090 F)

A satisfactory mixture can be obtained by experimenting with combinations of these three fluxes, used with brazing compositions of various melting points. Use of the No. 34 material, lowest in cost of the three types listed here, can reduce cost while still leaving the mixture with satisfactory fluxing properties for the brazing alloy being used.

Fixtures for holding the work in the furnace are a problem, as the flux will bite into stainless steel or Inconel. The brazing alloy will stick to steel, but will not form a usable bond. Caution in positioning is necessary when preparing the work for the furnace. A powdered stop-off material is available that can be mixed with water and painted onto areas where there is danger of sticking.

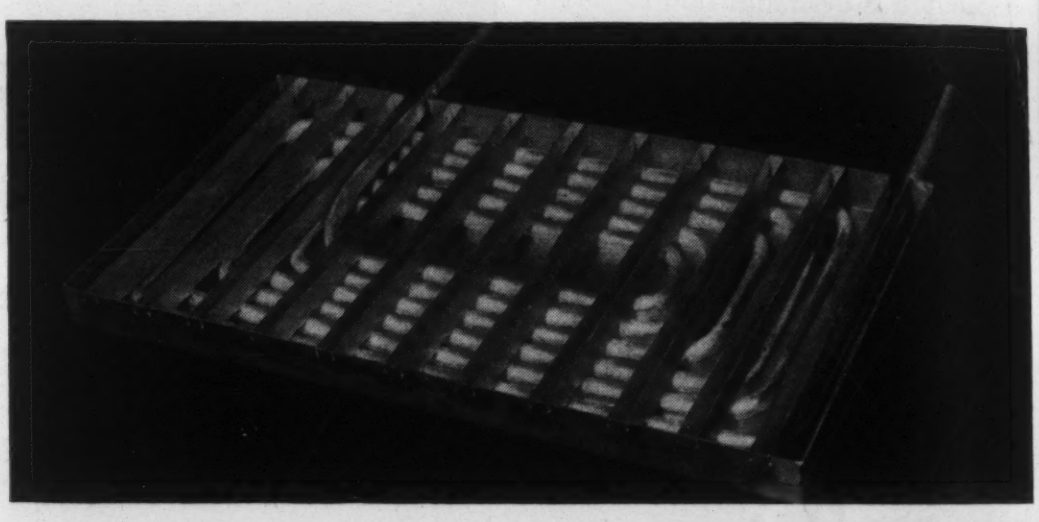
When the flux has been applied to the sheet aluminum, the formed tube is placed onto the sheet, carefully positioned, and weights are applied to hold it during brazing. The pieces are then put into the brazing furnace. This is an electric resistance-heated type with close control of temperature. A continuous chain conveyor carries the work into and through the furnace box at a rate that can be set on the furnace controls. As aluminum is not subject to excessive oxidation at elevated temperatures, it is not necessary to shield the work with a special atmosphere during brazing. The air in the furnace is recirculated to increase thermal efficiency, however.

Because of the metallurgy of aluminum brazing, close control of temperature and of uniformity of temperature is absolutely necessary for the achievement of satisfactory results. The brazing alloy melts in the range of 1100 F, while the aluminum alloys used for the base metal in the clad sheets will melt at temperatures about 50 to 100 F higher. The brazing alloy, coming up to fusing temperature, melts, and immediately begins to pick up aluminum from the base metal. However, as aluminum goes into solution in the brazing alloy, the percentage of silicon in the bonding material is decreased, and the melting point of the resulting alloy, higher in aluminum and lower in silicon, is higher than that of the original composition. The result is that after 2 to 6 min. at temperature the fused brazing alloy becomes pasty again, then solid. During the fluid state the brazing alloy is pulled into the contact areas by capillarity, and surface tension causes it to take a smooth fillet form. After the alloy enrichment has caused it to solidify, the work is removed from the furnace.

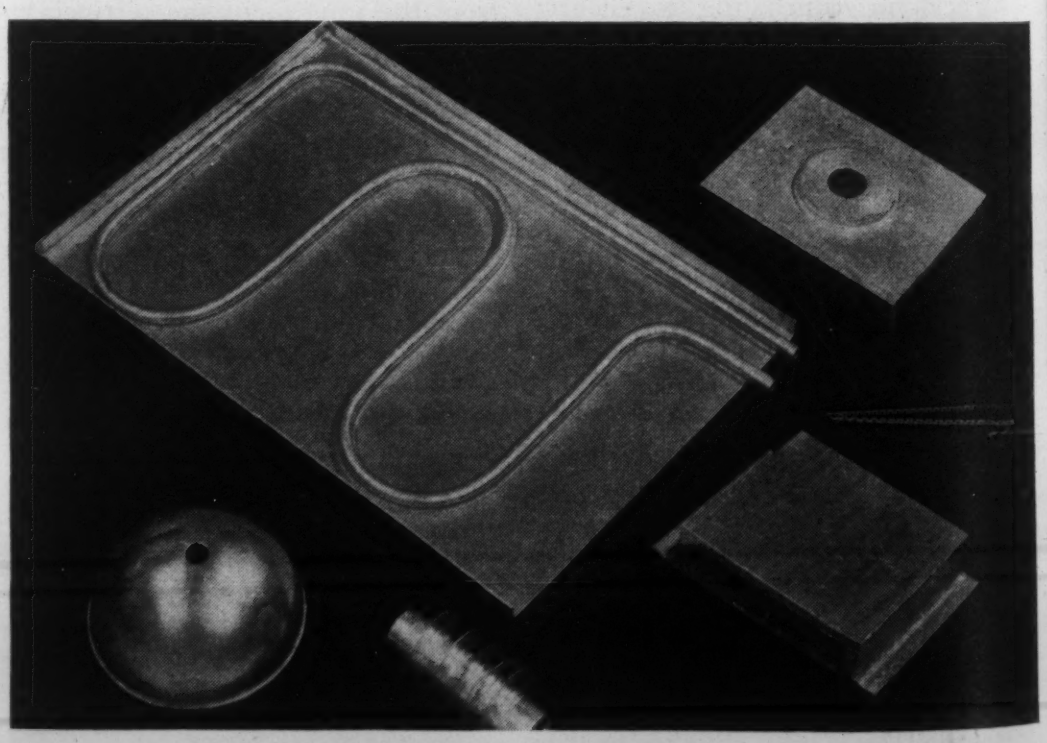
The work can now be air cooled, or it can be thrown into water for quick cooling if warpage is not a problem. The remains of the flux must be carefully removed, and for this purpose the assembly is soaked in water, and then scrubbed in hot water. A deflux tank provides the next cleaning step. Here the work is dipped into a bath consisting of 15% nitric acid and 0.25% hydrofluoric acid. After leaving the acid bath the work is carefully rinsed, and is then allodized in the solution prepared and sold by the American Chemical Paint Co. A final chromic acid dip completes the treatment of the work.

The liner sheet, with brazed-on aluminum tubing for the refrigerant, is still in the flat except for the flange along the top edge. The assembly is next formed into the four sides of a box on a large power brake. Notches in the flanges make this bending a simple operation. Assembly of the refrigerator liner is completed by clipping in the drawn bottom pan, forming the five sides of the open box.

Careful preparation of the work, and close control of time and temperature during the actual furnace brazing, are the keys to successful brazing of aluminum. The work is joined with a smooth, even fillet, strong, and providing a single metallic wall for maximum heat transfer.



A tubing and sheet assembly fabricated by brazing. (Courtesy Aluminum Co. of America)



Typical aluminum brazed parts showing the type of joining that can be accomplished. (Courtesy Aluminum Co. of America)

Recent Progress Made in Silicone Rubber Materials

Although initially developed for high temperature service, silicone rubbers are now being used in many other types of industrial applications.

by C. E. ARNTZEN and R. D. ROWLEY, Westinghouse Electric Corp.

• PRIOR TO 1940 the word "silicone" had little meaning to anyone except to those carrying out academic work on organometallic compounds. Today it is not uncommon to hear the word mentioned by people in all walks of life. This rapid recognition by so many people has resulted from the wide application silicone materials have found in such a short time. Although the justification for their investigation at first was due chiefly to their high temperature endurance, a large number of their applications at present do not depend on this property.

Silicone materials are now available as varnishes, paint vehicles, rubbers, oils, greases, laminating resins, water-proofing compounds, antifoam agents, mold release materials, heat transfer compounds and many combinations of these with other materials. Less than ten years ago, it was easily possible to discuss all silicones of commercial interest in a relatively short article; now so much work has been done that even a book would not adequately cover every phase. In order to give even a sketchy picture of silicone materials today, it is necessary to limit the discussion to a few types of this material. Therefore, this discussion is limited to silicone rubbers. In another article to appear shortly silicone paint vehicles will be covered.

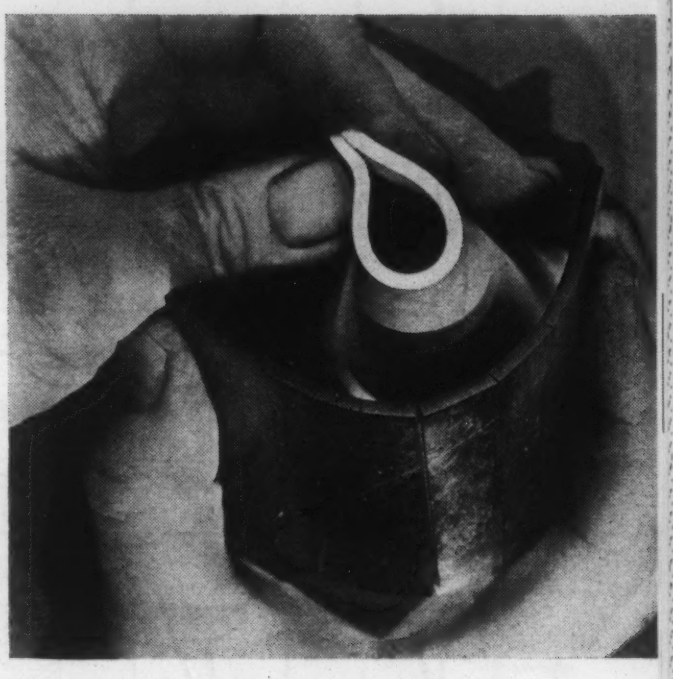
Production and Nature of Silicones

Silicones are obtained from the chemical modification of sand, part of the oxygen in the sand being replaced by hydrocarbon groups. The chemistry is complicated and involves a number of complex steps. Sand, coke from coal, and chlorine from brine, the starting materials, are processed to produce the organochlorosilanes, which are the intermediates in the preparation of silicones. Treatment of the organochlorosilanes with water converts them to intermediate compounds containing Si-OH groups that, in most cases, condense with each other immediately with the loss of water to form silicones.

While possessing many of the properties of other elastomers, both natural and synthetic, silicone rubbers are entirely different in their chemical nature. In natural and most synthetic rubbers, the "back-bone" of the polymeric molecule consists of long carbon to carbon chains. Such molecules are attacked by a combination of heat and air so that they deteriorate rapidly at temperatures in excess of 300 F. The silicone rubber polymer, on the other hand, contains a "back-bone" that consists of alternate silicone and oxygen atoms with two methyl groups attached to each silicone atom. The silicon-oxygen bond is responsible for the remarkable thermal stability of silicone rubber while the methyl groups impart flexibility.

The silicone gum or elastomer is milled with inorganic fillers on mixing rolls, just as is done with natural or synthetic rubber. Most of the fillers used in the rubber industry can be compounded with the polymeric silicone gum; however, the most common fillers used are Celite (diatomaceous earth), titanium dioxide, and iron oxide. These materials are desirable fillers due to their ability to withstand the temperature of 390 F. Carbon black, the filler used in most rubbers, gases badly at this temperature and is, therefore, not suitable for use with silicones.

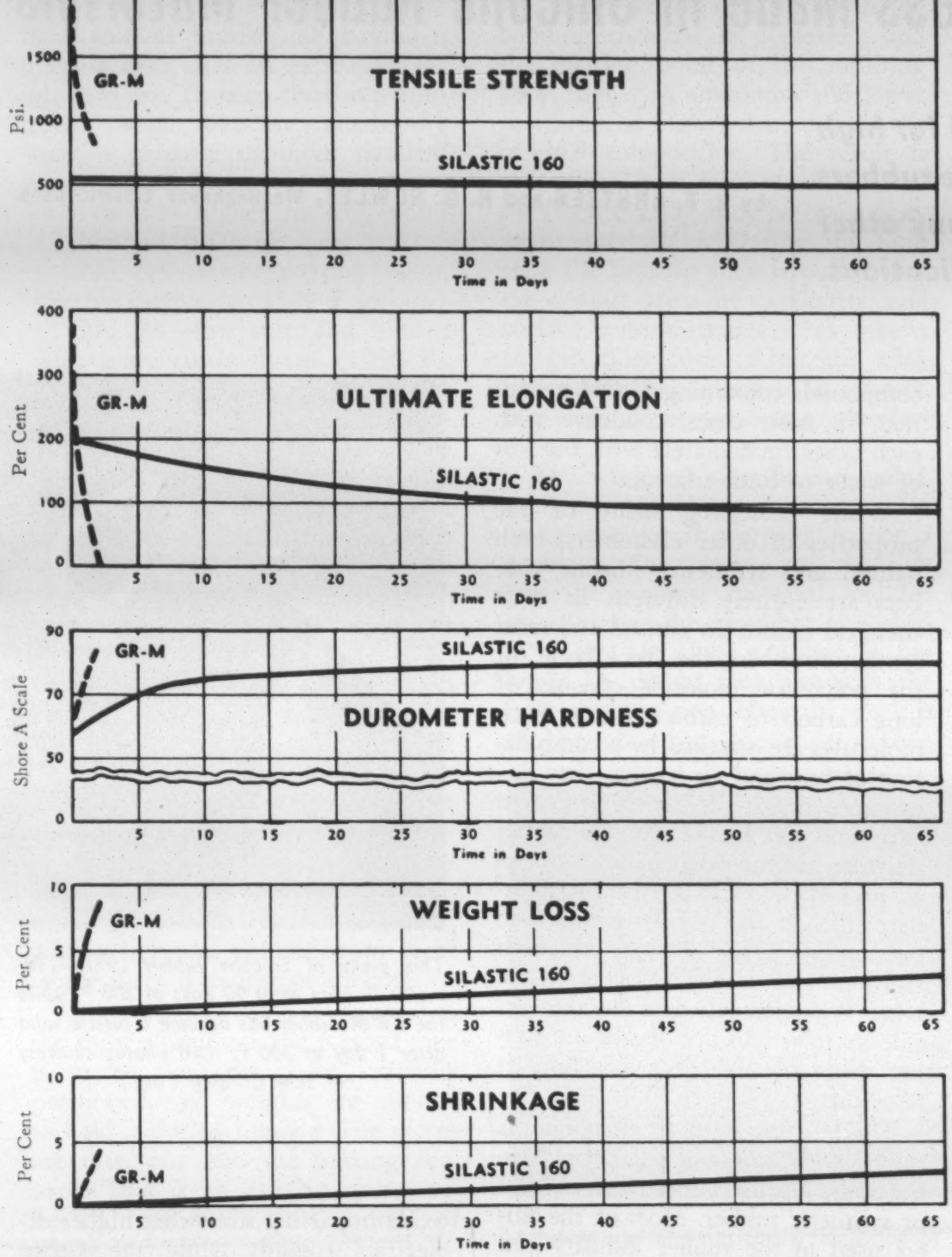
The silicone rubbers filled with Celite possess the greatest hardness, tensile strength, and chemical resistance but are low in elasticity and ultimate elongation. The titanium dioxide filled rubbers are softer and have lower tensile strength than the Celite filled materials but have greater elongation and elasticity. Both the Celite and titanium dioxide filled compounds are used as electrical insulation materials, the titanium dioxide imparting somewhat higher dielectric strength while the Celite filled compound possesses lower dielectric constant and power factor, especially at high frequency. Iron oxide imparts somewhat greater durability and is also used for economy. However, the iron oxide filled silicone rubber is not suitable for electrical uses due to low dielectric strength.



This piece of silicone rubber (white) remains flexible after 90 days at 300 F, while the GR-M rubber has become a brittle solid after 1 day at 300 F. (All photos courtesy of Dow Corning Corp.)

The long chain linear dimethylsilicone molecules will flow under heat and pressure. In order to minimize this flow, it is necessary to cross link the linear chains to produce a vulcanized rubber of low permanent set. A curing catalyst, therefore, is added during the mixing of the gum with the filler that will catalyze the cross linkage of the linear chains when cured by heat to an insoluble, infusible elastic material.

Silicone rubber is processed on standard rubber equipment. It can be extruded in standard continuous ex-



trusion machines, molded and vulcanized in steam presses, friction calendered, laminated, or coated by adopting conventional processes and standard equipment.

Silicone rubbers are available in two forms: a crepe form, fully compounded and ready for fabrication, and a paste form. The crepe form is used for molding, friction calendering, extruding, coating, and laminating. The pastes are produced in a consistency suitable for application by doctoring, roller coating, or spreading without the addition of solvents. However, if desired, these pastes can be thinned with solvents such as carbon tetrachloride or perchlorethylene and applied by painting, dipping or spraying.

Mechanical and Physical Properties

The tensile strength and tear strength of the present silicone rubber stocks are lower than most natural and synthetic rubbers. The tensile strengths of various vulcanized elastomers in both gum and titanium dioxide filler compositions (100 parts filler for 100 parts polymer) are given in Table 1. Table II lists typical properties of silicone rubbers produced by the Dow Corning Corp.

Glass cloth is used to reinforce silicone rubber, thereby imparting the physical properties of the fabric to the finished rubber part. Such reinforcement reduces the elongation of the rubber, but the physical strength is greatly increased. The silicone rubber can also be reinforced with cotton, nylon, and other organic fabrics but the usefulness of the silicone rubber then is limited to the range of the heat stability of the organic material.

Heat Stability—The most outstanding property of silicone rubber is its ability to endure temperatures both above and below the useful limits of other rubber materials. In this respect, silicone rubber is in a class by itself, maintaining its resiliency at temperatures up to 500 F and down to -58 F. The properties of test specimens are essentially unchanged by continuous exposure to air at temperatures of 302 to 356 F. Weight loss on aging at temperatures up to 392 F is negligible. Some formulations decompose at flame temperatures but do not sustain combustion; others ignite with difficulty and burn slowly. At elevated temperatures, silicone rubber flows under pressure, the degree of flow being proportional to the temperatures.

Studies of the effect of thermal aging indicate that the use of silicone rubbers increases the permissible operating temperatures for elastic materials by at least 100 F. The relative effect of aging at 300 F was studied by the Dow Corning Corp. using silicone rubber and samples of GR-M compounded for high temperature operation. Dow Corning silastic 160 was selected for this comparison because its properties are about average. Change in properties measured at room temperature after aging for various periods of time at 300 F are shown in accompanying charts.

The GR-M samples lost 56% of their original tensile strength in less than two days. The silicone rubber samples lost only 7% of their original tensile strength after 66 days. Furthermore, whatever tensile strength was retained by GR-M was of no practical importance because it had lost its elastic properties and had become brittle. The ultimate elongation of GR-M is nil after less than two days at 300 F while the silicone rubber retains 35% of its original

Table I—Tensile Strength Comparison of Elastomers

Polymer	Silicone Rubber	Natural	Synthetic*			
			GR-S	GR-I	Buna N	GR-M
Gum	400 psi.	3000 psi.	400 psi.	3000 psi.	600 psi.	3500 psi.
Filler	600 psi.	1500 psi.	700 psi.	1200 psi.	1000 psi.	1500 psi.

** GR-S is the designation for a co-polymer of butadiene and styrene; GR-I for butyl rubber, Buna N for a co-polymer, of butadiene with acrylonitrile, and GR-M for neoprene.*

Table II—Typical Physical Properties[1] of Silastic

(Determined on ⅛-in. sections molded 5 min. at 260 F and cured 4 hr. in an air oven at 480 F)

Silastic	Consistency[2] Before Vulcanizing	Color	Density at 77 F	Hardness[3] Shore A Scale	Tensile[4] Str., Psi.	Elongation[4], %	Elasticity[5] Shore	Impact[6] Resilience Bashore Resiliometer	Flex[7] DeMattia, Method B		Water Absorption[8]	
									Elongation, %	Number of Cycles	% by Weight	Mg. per Sq. In.
121*	Heavy Paste	Red	2.3	80-90	600	50	5	—	—	—	1.0	21
122	Heavy Paste	Grey	1.5	85-95	650	40	5	—	—	—	1.4	14
123	Thin Paste	Grey	1.4	80-90	650	40	5	42	—	—	1.8	16
124*	Thin Paste	Red	1.7	40-50	300	150	40	55	50	500,000	1.6	22
125	Thin Paste	White	1.7	40-50	400	200	40	52	50	500,000	1.4	20
126	Thin Paste	White	1.7	50-60	300	100	30	52	20	350,000	1.5	14
150	Stock	White	1.9	45-55	400	300	30	53	70	250,000	2.6	47
160	Stock	White	2.1	55-65	600	200	40	52	50	150,000	0.9	17
161*	Stock	Red	2.1	55-65	600	200	40	40	50	150,000	1.0	22
167	Stock	White	2.0	60-70	600	110	40	54	20	80,000	1.3	25
180	Stock	White	1.6	75-85	700	75	15	47	20	7,000	0.5	7
181	Stock	Grey	1.3	75-85	650	90	8	35	20	50,000	1.1	15

[1] *These properties were determined in the Dow Corning laboratories and are believed to be average values, but they are not guaranteed or designed for use as specifications. The data given are intended to enable a selection of the Silastic best suited to a given application.*

[2] *Williams plasticity values for heavy pastes range from 60 to 90, thin pastes from 15 to 50, and stocks from 100 to 180. This value is given as thickness in inches of a 2-cc. sample after 3 min. at room temperature in a William Plastometer, du Pont model, manufactured by Scott Testers Inc., Providence, R. I.*

[3] *Hardness determined according to ASTM D 676-44T.*

[4] *Tensile strength in psi. and elongation determined according to ASTM D 412-41.*

[5] *Shore elasticity measured by Shore Elastometer, manufactured by the Shore Instrument & Manufacturing Co., Inc., Jamaica, N. Y. Test procedure described in their bulletin R-4.*

[6] *Per cent impact resilience (Bashore Resiliometer) determined at 77 F on 1-in. cubes of molded Silastic.*

[7] *Flex (DeMattia, Method B) determined according to ASTM D 430-40 on samples cut according to specification from ⅛-in. molded sheets. These samples are alternately stretched about 25% of the ultimate elongation for the sample tested and released from tension at a rate of 363 cycles a min.*

[8] *After seven days immersion at room temperature.*

* *Silastic 121 was previously referred to as Silastic 121R; Silastic 124 was previously 125R; Silastic 161 was previously 160R.*

elongation after 66 days at this temperature. The effect of aging on the flexibility of GR-M and silicone rubber is illustrated in an accompanying photograph.

Low Temperature Behavior—Silicone rubber has outstanding low temperature flexibility without the addition of plasticizers, which is the usual method employed with other elastomers to improve low temperature characteristics at the expense of heat resistance. Hence, silicone rubber is equally useful at either high or low temperatures. Brittle points for the various types of the Dow-Corning rubbers now available range from -70 to -100 F.

Flexing at temperatures only slightly above the brittle point does not change the properties of silicone rubber or lessen its usefulness at normal or elevated temperatures. Elevated temperatures likewise do not lessen its usefulness at low temperatures or increase its brittle point.

Solvent Resistance — Vulcanized silicone rubbers are swelled to various degrees by different types of solvents. The actual swelling is dependent on the amount and type of filler on the rubber. For many applications silicone rubbers have been found to be stable to 3% hydrogen peroxide, to most bases and weak acids, to some strong acids, to salt solutions, and to oils. Aromatic solvents, gasoline, and carbon tetrachloride, however, cause considerable swelling but do not result in serious deterioration because the rubber regains most of its original physical properties after the solvent has been removed. Silicone rubber is more resistant than any other elastic material to ozone, tricresyl phosphate, and the chlorinated hydrocarbon fluids used in liquid cooled transformers.

Table III—Effect of Temperature on Physical Properties of Silastic 125

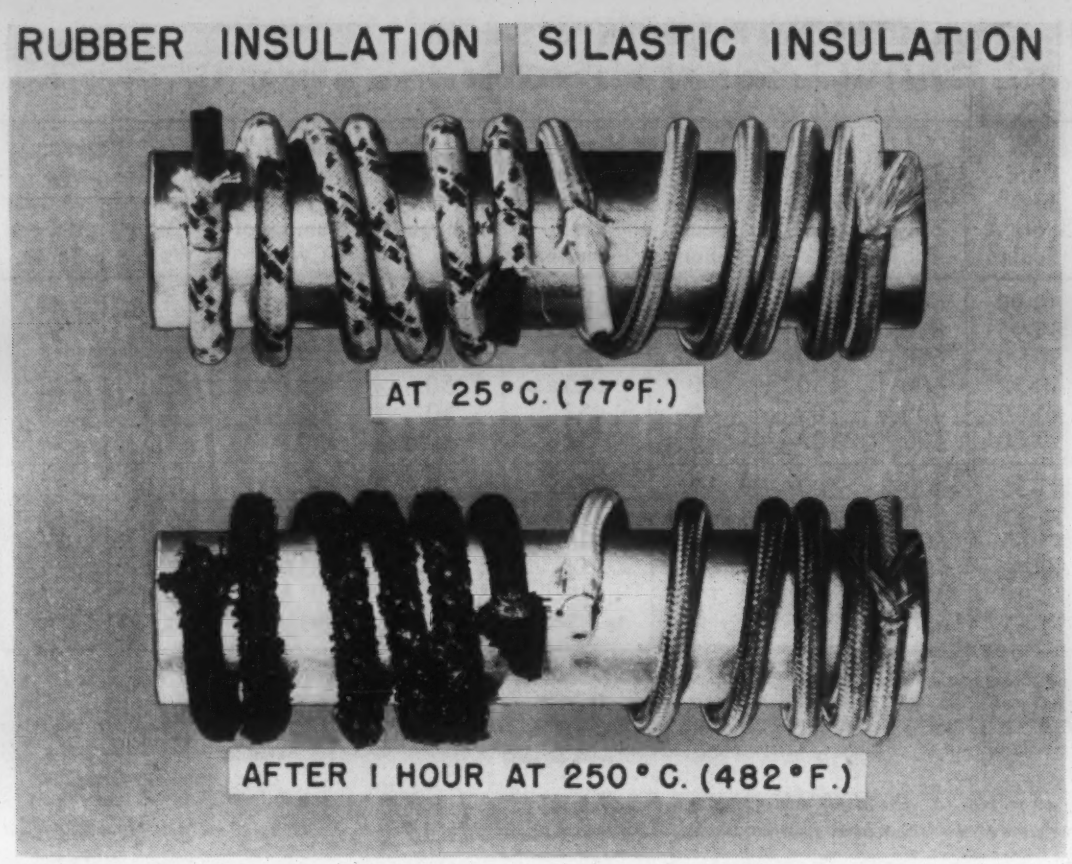
Temp., C	Ten. Str., Psi.	Hardness Shore A Scale	Impact Resilience Bashore Resiliometer	% Compression Set* ASTM-0-359-375	Young's Modulus (in Flexure) Psi.
—65	700	65	14	4	—
—25	630	56	25	20	420
0	600	50	30	24	395
25	595	49	34	27	395
50	595	48	38	32	390
75	585	48	43	35	390
100	580	47	46	40	385
125	570	46	47	44	380
150	560	46	46	50	375
175	550	44	44	55	360
200	535	45	42	61	345

* *Silicone rubbers with improved compression set characteristics are now being developed.*

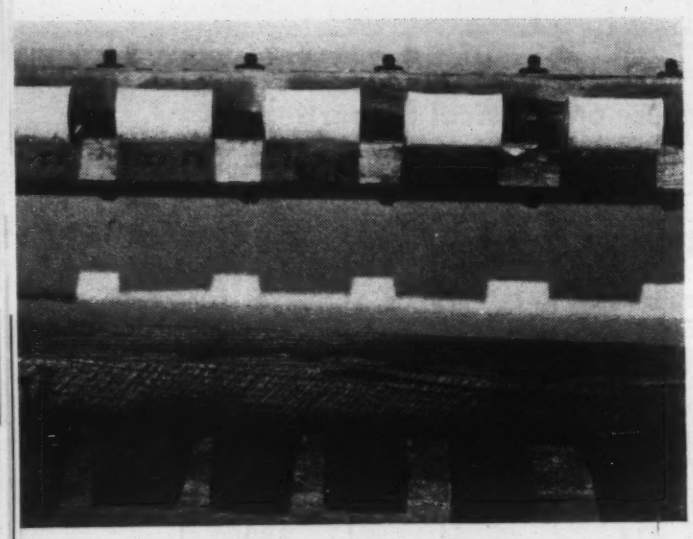
At temperatures above 175 F most organic rubber gaskets and seals are useless because they deteriorate rapidly in contact with oil. Silicone rubber, however, shows very good resistance to oil at temperatures ranging from 175 to 464 F. It does swell to a certain extent but the swelling does not cause any serious deterioration.

Weather Resistance—In addition to retaining its elastic properties over a remarkably wide temperature range, silicone rubber is resistant to water, ultra violet rays, and ozone. It remains soft and flexible when stressed and exposed to outdoor weathering for long periods of time. Some organic rubbers have good resistance to weathering if they are not subjected to mechanical stress, but when weathered under strain by stretching or bending, cracks appear after a short time.

An accompanying photograph shows the exceptional weather resistance of silicone rubber as compared



Comparison of organic rubber and silicone rubber used as insulation. Organic rubber is on the left, silicone rubber is on the right.



Samples of silicone rubber (white) show no signs of deterioration, while those of organic rubber are cracked after one year of outdoor weathering.

to a weather resistant organic rubber subjected to the same stresses and exposed to outdoor weathering for 12 months. The white silicone rubber samples are sound in both stressed and unstressed areas while the black organic rubber samples are sound in the unstressed areas, but badly cracked in the stressed areas.

Adhesion — Silicone rubber adheres readily to a properly prepared glass surface, this adhesion existing to a plain glass surface or to a glass fabric. However, special technique is required in order to bond silicone rubber to metal surfaces. Adhesion in this case is usually obtained by using a silicone resin for a cement.

Electrical Properties — The silicone rubbers possess excellent electrical properties under wide temperature and frequency ranges. The material undergoes little change in dielectric strength with temperature or humidity, and the loss factor remains at a low value at frequencies as great as 10^8 cycles per sec.

In addition, silicone rubber has two chemical properties that make it valuable as an insulating material. It is highly resistant to ozone, which is produced where there is corona. Samples show no cracking after 24 hr. in an atmosphere containing 0.01% ozone while Buna S rubber developed surface cracks after a few minutes in the same atmosphere.

A glass fabric impregnated with silicone rubber possesses the physical properties of the fabric and the electrical and thermal stability characteristics of both materials. The power factor and dielectric constant are better for the glass fabric reinforced material than for silicone rubber itself, but the dielectric strength is reduced. The lower dielectric strength is attributed to the existence of gas pockets in the coated fabric.

Uses of Silicone Rubber

Silicone rubber has allowed equipment designs which were previously not possible because a suitable material was not available. As examples, several typical applications of the silicone rubbers are given below.

Gasketing — An ideal gasketing material possesses low compression set at operating temperatures and resistance to attack by the reagents to which the gasket is exposed. Silicone rubber in many cases meets these requirements more completely than any other resilient material and over a far wider temperature range (—60 to 400 F).

Silicone rubber gaskets are used as a seal for the steam chamber of steam heated irons, for certain Navy search lights and signal lights which operate in a range of —40 to 400 F, for lighting equipment such as hospital operating lamps, infra red baking lamp assemblies and flood lamps, for baking and drying ovens, for hot spots on stationary diesel engines, gas turbines, air compressors, etc., and for pipe connections carrying fluids at high temperatures.

Belting — Since silicone rubbers are odorless, tasteless, and nontoxic, wire-cloth reinforced silicone rubber belts are used in the food processing industries. Prepared foods can be placed directly upon the belt and dehydrated at temperature which may reach 435 F. The rubber is unaffected by the water vapor or the food fluids. Processing belts are also made from glass fabrics coated with silicone rubbers. These belts are used in continuous drying ovens where solvent evaporation, heat treatment, and degasification processes are carried out.

Electrical Insulation — Silicone rubber stocks are extruded over wire to form a durable and heat stable insulation for the wiring of electric ovens, furnaces, transformers, and silicone insulated motors. An accompanying illustration shows the effect of aging for one hour at 480 F on organic rubber insulated wire and on a silicone rubber insulated wire.

Silicone rubber stocks and pastes also are used for coating glass and asbestos cloth and tape designed for insulating electrical machines. Silicone rubber coated inorganic cloth and tape are used where organic or organic coated insulating materials fail because of heat, cold, moisture, ozone, weathering, attack by salt solutions or chemical fumes. They are especially useful where sharp bends without cracking or crazing are required.

Silicone rubber calking and sealing pastes are used in electrical machinery operating at temperatures up to 480 F. They prove very useful for such applications since they oxidize and shrink little and lose little flexibility even at this high operating temperature.

Aluminum-Vinyl "Cold Solder"

Has Interesting Possibilities for Industry

Putty-like filler pastes composed of aluminum powder and vinyl resin have many potential uses as a repair material for metals.

by EDWIN LAIRD CADY

• MODERN ALUMINUM-VINYL cold solder is something of a "sleeper" product in that dozens of industries which could use it with profit seem never to have heard of it. Information of any kind is sparse and difficult to get. The product appeared on the market about two years ago, and found an immediate sale as a repair material for dented and broken automobile fenders. One maker is confidentially reported to have sales as high as 300,000 gal. a month for this market alone. However, little attention seems to have been devoted to developing the kinds of engineering data which will be needed before the product can find its full place as a raw material and a maintenance material of industry.

There are several formulations. Some of them are protected, or at least are not publicized. A formula openly announced is:

Atomized aluminum powder	60%
Vinylite resin	10%
Acetone	30%

The laboratory manager of one company which has developed a large sale pointed out that the type of vinyl resin makes considerable difference; that this formula might be varied to develop a special product for some industrial uses; that this proportion of solvent keeps the product still useful when the ordinary garage man gets down to the bottom of a quart can but might not be best for some production line conditions. The present standard products can be used for thousands of purposes in industry, but further developments of properties are to be expected.

In addition, some of the new developments may be quite different from automobile repair grades. The use of plastics other than vinyl is under intensive study, and products made with nitro cellulose and cellulose acetate plastics are reported to be on the market. Colloidal silicon may displace the aluminum powder for combination with the vinyl for

Of the three holes that were originally in this specimen, the center one has been filled in with aluminum putty while the one at the right, previously filled in, has now been sandpapered smooth. (Courtesy Reynolds Metals)

some purposes. The use of other "loadings" for this plastic is under study. And altogether, the development of loaded plastics, which can be applied in paste or liquid forms, may be interesting to the materials engineer during the next few years.

Properties

The physical properties of the present standard aluminum-vinyl product appear to be known only as their knowledge was needed for automobile repair work. Some of the present data are:

Bending—Ability of the applied product to be bent without cracking depends somewhat upon the section thickness but is largely unknown. A 1/32-in. thick film can be bent over a 4-in. mandrel without cracking. No attempts to find out how much smaller a radius it would stand are known to have been made.

Heat Resistance—Will withstand steady temperatures of from 400 to 500 F, and intermittent temperatures (the heat applied and then quickly removed) somewhat higher than that.

Adhesion—Excellent to clean metal, and even better to slightly roughened clean metal. No index figures are given as to adhesion strength either in tension or in shear. But the shear adhesion undoubtedly is the higher.

Hardness—"Readily filed or sanded, but too hard to be cut with a knife." No index figures are known to have been developed by actual hardness testing. "Substantially harder than soft solder."

Coefficient of Thermal Expansion—Unmeasured. Strips more than 5 ft. long have been applied to rents in automobile bodies and have stood up for more than one year. But this may be an indication that the elasticity of the material is such that it expands and contracts in conformity with the steel, rather than that the thermal expansion figure would be found to be close to that of steel.

Brittleness—When struck with a ball peen hammer, the fully hardened material is dented and deformed but not cracked. Otherwise, the degree of brittleness is unknown.

Elasticity, Creep—Modulus is unknown.

Cold Resistance, Cold Strength—Satisfactory for automobile use. Otherwise unknown.

Corrosion Resistance—Resistance to water and moisture is excellent. No data on other corrosion resistance. In automobile use the product ordinarily is painted; therefore data on corrosion resistance have been of little interest.

Fatigue Resistance—Unmeasured. This is the property which prospective industrial users most often inquire about; therefore it may be studied in the near future.

Surface Finish—The product can be filed, sanded or buffed to a smooth finish. The appearance is that of metallic aluminum. The ultimate smoothness obtainable is unknown.

Application Methods

The first application step is to clean the surfaces to which the product is to adhere. All paint must be removed, since the solvent would penetrate and lift up any old paint or enamel which might remain. But the meticulous removal of paint from fine cracks, pin holes and other surface imperfections difficult to clean out is not always necessary. The metal should be slightly roughened for better adhesion of the product.

Dryness of surface is highly desirable but not completely mandatory. Adhesion is best when the surface is dry. But emergency repairs have been made to vessels which contained water. The water pressure may not be great enough to eject the cold solder before the solder can dry.

The standard mix of aluminum-vinyl cold solder is in paste form, of consistency somewhat thinner than that of ordinary putty. It can be applied with a spatula, a putty knife, or any other convenient tool.

Backing-up of the area to be filled sometimes is desirable to prevent wastage of material which otherwise would fall out of the reverse side of the cut that is being repaired. The backing up can be done with friction tape, adhesive tape, plastic strips, or any of the ordinary kinds of masking tapes.

The thickness of the total section to be built up depends more often upon the depth of the depression to be filled than upon the need to increase strength by increasing cross section. A 1/32-in. section is the thinnest ordinarily used, and ¼ in. is the thickest, although sections as thick as 1 in. have been built for test and for some commercial purposes.

Setting-up and hardening of the

Cold solders have many potential uses in the foundry for pattern changes, mold repairs, and filling in surface defects.

Where welding creates a pitted surface, cold solders can be used to fill holes and present a smooth surface.

product is accomplished by evacuation of the solvent. And since the solvent tends to leave the surface first, and thus to leave a hardened surface layer which acts as a barrier to escape of solvent from the interior, the time needed for drying is not directly proportional to section thickness. Typical drying times for typical sections are:

A 1/32-in thick section drys in ½ hr.

A 1/16-in. thick section requires 5 to 6 hr.

A ¼-in. thick section must dry over night or longer.

Methods of applying thick sections, then, depend upon the practicalities of time tables. A ¼-in. section, applied in 1/32-in. increments with drying times in between, would be done in about 4 hr. But if longer drying time is readily available, then the entire section might as well be applied at once and the work set aside for a day or so.

For industrial uses, especially the production line ones, further study of drying time needs to be made. Garages have been known to speed drying by the use of blow torches, and although the solvent is fire hazardous and the intense heat is likely to cause blister troubles in the cold solder, the method worked. Infra-red, and many other quick drying methods, should work well in industry.

Finishing is easy. The material is not gummy and neither clogs files nor loads sand paper.

Preparation of the surface for painting requires the same treatment that would be given to any aluminum surface. Acids sometimes are used, but the most common preparation is to apply an aluminum paint primer.

Industrial Uses

Use of this product by industry probably will increase in direct ratio to the gain of knowledge of its properties by industry. Some of the present uses are:

Sheet Metal Repairs — Guards, guides, gutters, tanks.

Heated Object Repairs—Temperatures to 400 to 500 F.

Water Pipe and Water Tank Repairs.

Aluminum Castings Surfacing—Castings having blow holes or other surface defects can be coated or covered. The product yields a "natural aluminum" colored surface.

Other Castings—Where the casting tends to have a pitted or otherwise defective surface, and the only requirement is that that surface be smooth so it will present a good appearance when painted. Also, when deeper pits merely need filling to correct bad appearance.

Pistons—Automotive and other pistons are repaired with this material. It withstands the pounding as well as the temperature.

Weldments—Where the welding procedure creates a rough or pitted surface which merely needs building up and smoothening.

Models—This material can be built up and then shaped off by increments, an easy and effective way of building a model or a mock up of a machine part, a tool, or a product that is to be offered for sale.

Decorative—Aluminum surfaced decorative parts or items can easily be created.

Molds—For producing the patterns for precision investment castings, for some plastics samples work, and other purposes, molds can be produced with this material either by carving the hardened material itself or by forming the material about any available hard models. The models must be so coated that the soft solder will not adhere to them.

Crevice Filling—Where sheet metal pieces are joined by bending the edges and then riveting or spot welding through the bends, and it is desired to present an uninterrupted surface, this material is an excellent crevice filler.

Pattern Changes and Repairs—Fillets and other sections can be built up on foundry patterns.

Makers and Sellers—A complete list of the makers and jobbers of this product is not available. Some of the known sources of supply are:

Craftint Manufacturing Co., Cleveland, Ohio

A. P. Deckert Co., Buffalo, N. Y.

Durol Products Co., Cleveland, Ohio

Howard Metal Products Co., Cleveland, Ohio

Interchemical Corp., Wooster, Ohio

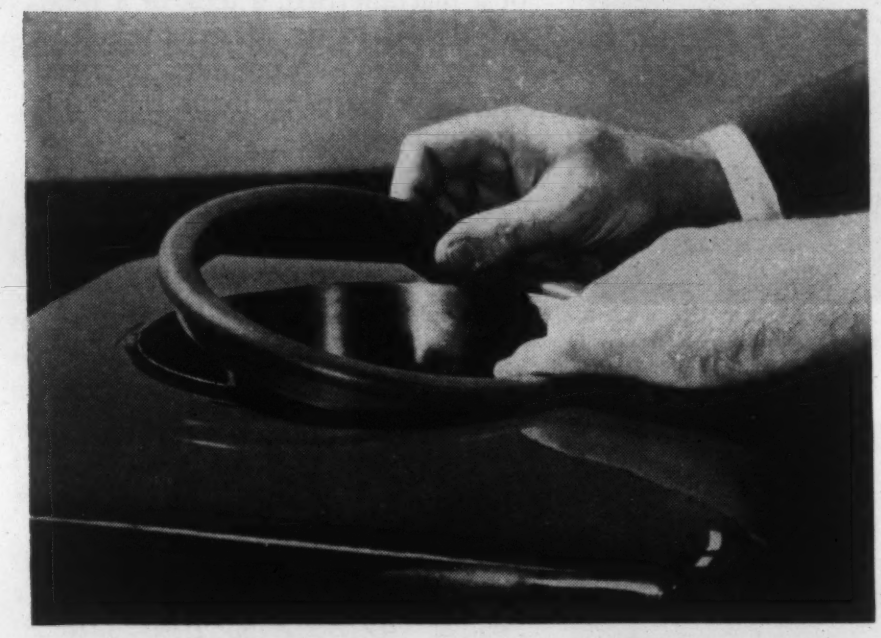
Sheffield Bronze Paint Corp., Cleveland, Ohio

Western States Lacquer Co., Los Angeles, Calif.

Some of the trade names under which the product is sold are Savex, Quik Metal, New Metal, Taub, and Crosby.

Materials at Work

Here is materials engineering in action . . .
New materials in their intended uses . . .
Older, basic materials in new applications . . .



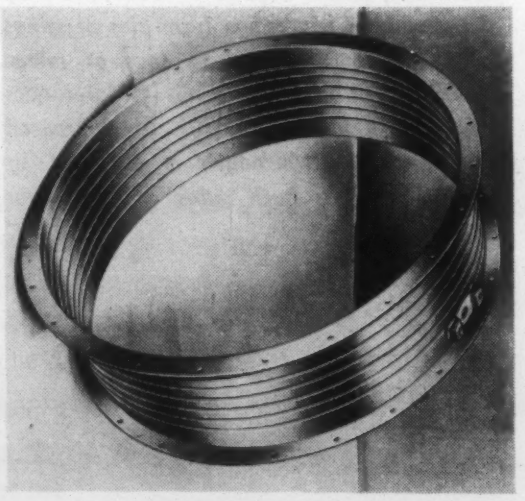
POLYVINYL GASKET

Manufacturers of bottle compartment water coolers have long been plagued with the problem of odor and taste being imparted to water by the molded rubber sealing gasket which is seated between bottle and cabinet. Although the gasket never comes in contact with the water in the cooler, the rubbery taste and odor is transmitted from the gasket through the air. To overcome this difficulty, an extruded, heat sealed plastic gasket made from Geon, a product of B. F. Goodrich Chemical Co., is used on the water coolers made by Ebco Manufacturing Co. The polyvinyl plastic used is impervious to mildew, oils, acids, or gases, and retains its shape and pliability under varying conditions of temperature. In addition, it offers non-fraying characteristics and is easy to keep clean.

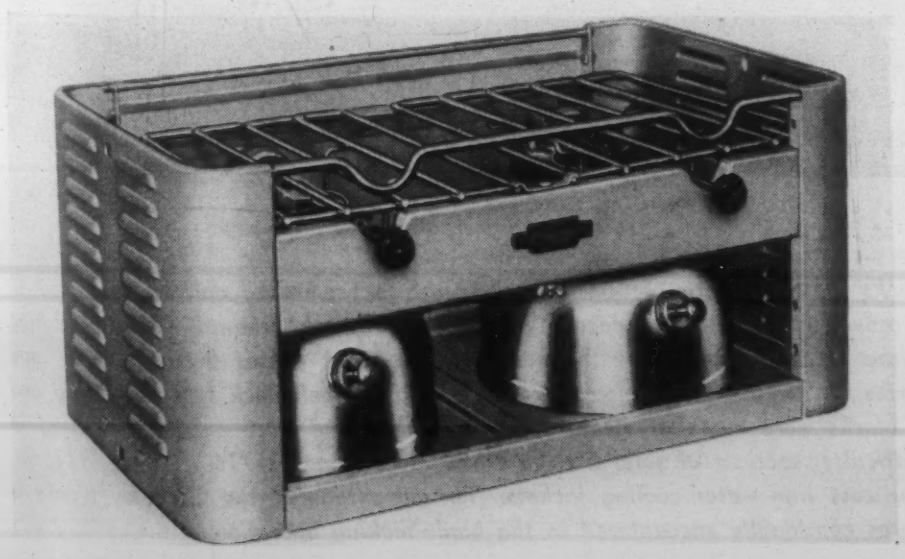
ALNESIUM BOTTLE CARRIER

Replacing the wood cases formerly used, this newly-designed all-metal bottle carrier is manufactured by Weiner-Stevenson Co. for the Coca-Cola Co. Since the old-type cases splintered easily, required frequent maintenance, and generally deteriorated rapidly, an aluminum alloy containing magnesium was selected as the basic material for the new carrier, thus assuring a strong, lightweight and sanitary product which cannot rust, remains relatively dirt-free, and needs no maintenance work. Additional durability is obtained in the new case by use of embossed separators and rounded corners. Multiple thicknesses of metal have been added at all points of particular stress. Positive jointing of parts is achieved by mechanical interlocking, and reinforcing wires are rolled into top and bottom edges for increased rigidity and strength. The interior of the case, along with its load of 24 bottles, is constructed so as to "float" in the frame. Cross rods are rubber insulated for further protection against bottle breakage. The new case weighs 3½ lb. as compared to the 6 to 7 lb. of the former wooden carrier.

PLASTIC TIME SWITCH COMPONENTS *Offering resistance to arcing and providing insulating properties in parts requiring unusual dimensional stability, a fast-curing alkyd compound produced by Plaskon Div. of Libbey-Owens-Ford is used for the terminal and contact blocks of time switches manufactured by Sangamo Electric Co. This mineral-filled alkyd plastic was developed primarily for electrical and mechanical applications, and its curing time is measured in seconds. A urea formaldehyde thermosetting compound, also produced by Plaskon, is used for the case and cover of the Sangamo switch.*

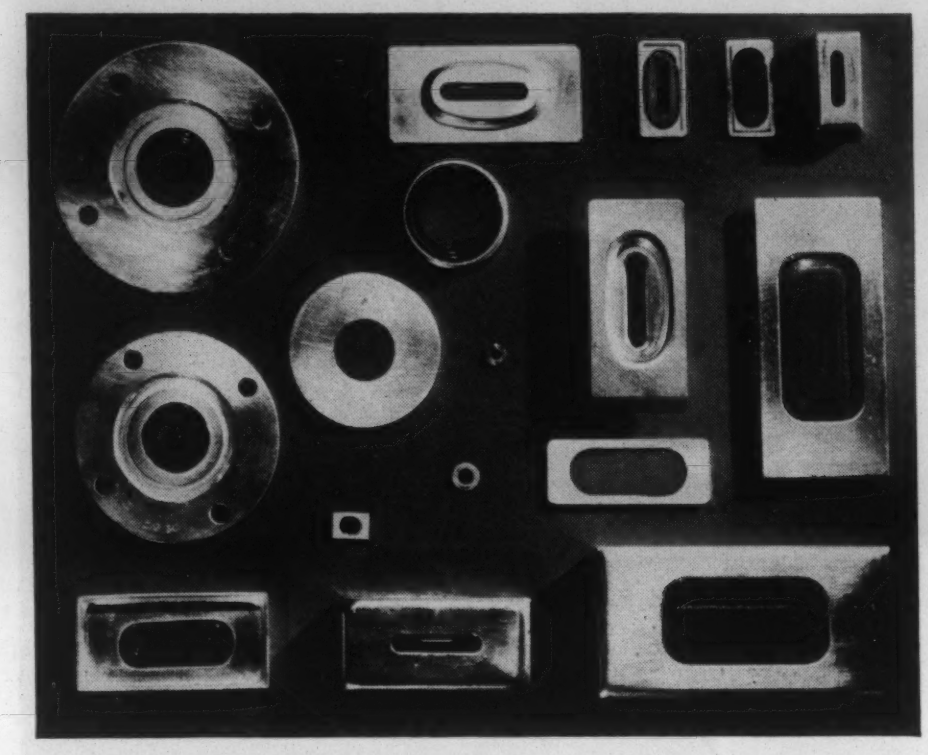


ALUMINUM OIL COOLER *Fabricated from a 36-ft. length of ⅜-in. O.D. by 0.049-in. wall 2-S aluminum tubing, this oil cooler is produced by B. H. Aircraft Co., Inc. for the Westinghouse "Yankee" Turbojet J34 engine which powers the Navy's Banshee, Pirate, and Skyrocket and the Army's XP-85, XP-87, XP-88, and XP-89. The tubing is formed to the required shape, rolled, and then continuously brazed inside and outside. The coil is brazed to two forged aluminum flanges which are then finished, machined, and drilled. The final assembly is subject to a pressure test of 250 psi. prior to installation.*

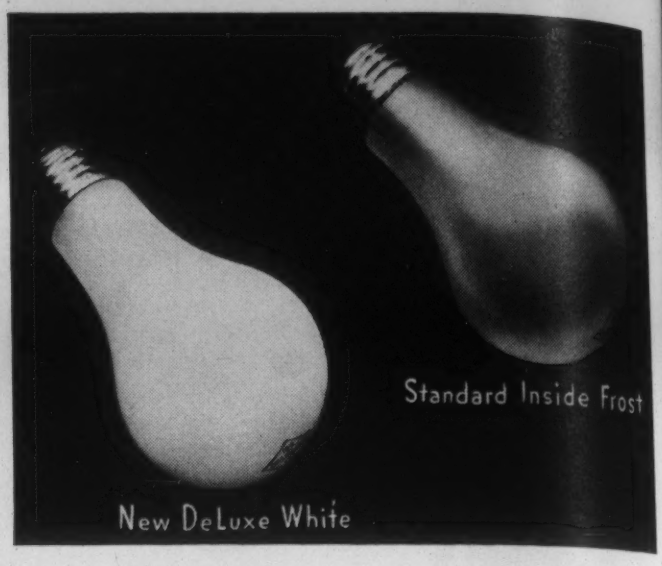


BRASS-ALUMINUM-STAINLESS STOVE *This two-burner, kerosene-fired hot plate is manufactured by the Coleman Co. for marine use. The two separate burners of this galley unit are made of brass and stainless steel, each having a single brass fount with a zinc bond steel bottom. The casing of the stove is heavy gage aluminum; the end pieces measuring 0.064 in. thick and the bottom piece 0.040 in. The casing has been given the Alumilite finish for added appearance and corrosion resistance. A center-divided and hinged stainless steel grate permits easy removal of one or both burners for cleaning.*

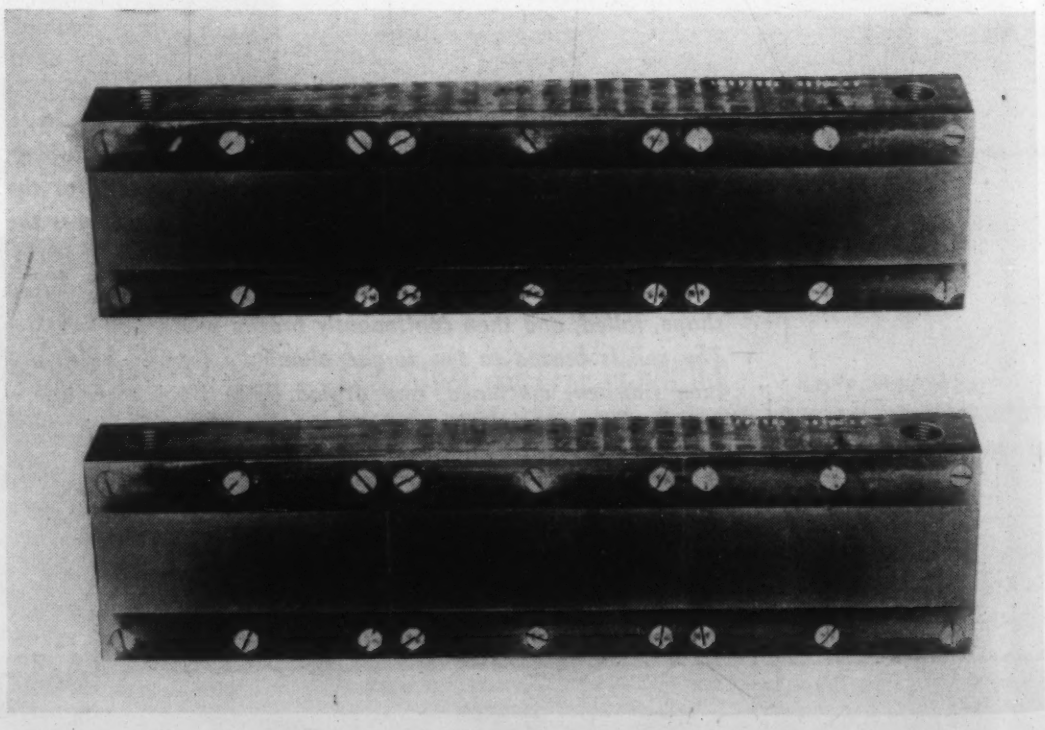
Materials at Work



GLASS-KOVAR WAVEGUIDE WINDOWS *Designed to permit silver soldering without damage to microwaveguide systems operating at frequencies ranging from 3000 to 40,000 megacycles, these glass and kovar windows are produced by Sylvania Electric Products, Inc. Glass stress is eliminated in these units at relatively high temperature differentials, thus making them available in a wide variety of shapes and contours for narrow and wide band transmissions. Power losses range from 0.02 to 0.1 db., and for frequencies above 3500 mc., the windows will stand pressures up to 65 psi. absolute. Dimensional tolerances, which depend on both the frequency of the window and the size of the window iris, range from plus or minus 0.005 in. at 3000 mc. to plus or minus 0.0005 in. at 30,000 mc. Glass tolerances vary from 0.001 to 0.0001 in. Increased glass-metal seal strength is obtained by beveling one or both sides of the kovar section.*



SILICA-COATED BULB *Providing a soft white light of better diffusion and quality, the newly developed inside coating of this 100-watt A-21 bulb supplants the ordinary inside frosting effect generally used on incandescent bulbs. Developed jointly by the Champion Lamp Works and Monsanto Chemical Co., this coating consists of finely ground silica applied to the interior of the glass bulb. Use of the coated bulb is particularly suitable for applications where lamps must be partially or completely unshielded and where uniform lamp brightness is desired.*



CEMENTED CARBIDE QUENCH BLOCKS *Quench blocks protected with sections of solid Carboloy cemented carbide are used to assure correct tempering of razor blade stock as well as to reduce scrap and the necessity of constant block renewal. The quenching device consists of two sets of water-cooled blocks. The sets are pressed together as the heated blade stock passes between them, and contact with the cold surfaces of the blocks tempers the blades. In addition, the blocks prevent the thin steel stock from wrinkling and warping during tempering operations. Originally, the quench blocks were made of steel. These scratched and wore quickly, resulting in soft spots in the finished razor blades. To eliminate this difficulty, sections of solid carbide metal measuring 1-11/16 in. wide, 3/16 in. thick, and 4 in. long were mechanically attached to brass or cast iron water cooling jackets. The advantage of the Carboloy blocks is that they cannot become annealed under the high temperatures continually encountered in the blade-making operation.*

Materials & Methods Manual

This is another in a series of comprehensive articles on engineering materials and their processing. Each is complete in itself. These special sections provide the reader with useful data on characteristics of materials or fabricated parts and on their processing and application

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Controlled Atmospheres for Metals

by L. F. Spencer, Chief Metallurgist, Landers, Frary & Clark

Controlled atmospheres are widely used in industry either to promote or prevent surface reactions on metals. This manual is concerned chiefly with protective atmospheres—those atmospheres used to prevent surface oxidation of steel and nonferrous metals. The technical characteristics and specific applications of the various types of protective atmospheres are discussed and attention is given to the economic desirability of utilizing controlled atmospheres.

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Introduction

The production of a specific and measurable composite atmosphere, either by controlled additions to a furnace or container, or by an auxiliary unit, generally has one of two functions in industry:

1. The *additive* atmosphere can be utilized to promote a surface reaction, as in gas carburizing, nitriding, cyaniding, etc. The purpose of this type of reaction is usually to improve the mechanical properties of the metal for a definite application.

2. The *protective* atmosphere can be utilized to prevent a surface reaction such as oxidation from occurring during a heating cycle, as in annealing, hardening, furnace brazing, etc. The purpose of this type of operation is to maintain the physical and mechanical properties of the parts submitted to the heating operation.

This manual will discuss the applications of industrial controlled atmospheres in the processing of ferrous and nonferrous metals. Some space will be devoted to the additive atmospheres utilized in carbon restoration and case-hardening of steels, but the major emphasis will be placed on protective atmospheres. The various types of atmospheres available and their specific applications in metal processing will be stressed. It is not the purpose of this manual to attempt to describe the equipment used in controlled atmosphere work, or to present in detail the theories of oxidation and atmosphere-metal equilibrium.

The purpose of an additive reaction is the formation of a hard, strong wear-resistant outside "case" or the restoration of carbon to a decarburized area. Reaction products liberated at the surface diffuse into the metal and add to the carbon content or react with the iron to form finely distributed wear-resistant particles. The driving force in this process is realized by maintaining the concentration of the active agents considerably higher in the atmosphere used than in the surface heated. The case-hardening operations are of use chiefly in the production of tools, dies and bearing surfaces.

The applications of protective atmospheres are more widespread. The formation of oxidation products on metals, either as a visible scale addition or as a decarburized surface skin resulting from a heating cycle, is recognized commercially as a distinct liability. Basic industries and fabricating plants necessarily employ corrective measures to either minimize or completely eliminate this undesirable condition, the specific method of correction being dependent upon both the material and the particular operation involved.

Oxide formations usually do not protect the underlying metal from further attack; instead, a progressive attack occurs until the entire metal sectional area has been dissipated. The exact nature of this condition depends on the chemical composition of the steel; the time and temperature of exposure to an oxidizing influence; constancy of atmosphere, whether oxidizing, reducing, or both alternately; and, at times, the method of working after a heating cycle.

Probable analysis of a flue gas producing scaling is: very little carbon monoxide; a relatively high percentage of carbon dioxide; excess oxygen; and water vapor. Increasing the carbon monoxide proportion to 15% practically eliminates scaling (although the surface is not clean), but this practice involves wasting a huge proportion of fuel to obtain so great an oxygen deficiency.

An important difficulty encountered in reducing scaling in an open-fired furnace is the strong adhesion of the thinner scale. A tight-adhering scale can easily mar the quality of a component part; thus, in a hardening operation, the tight scale may retard the cooling rate sufficiently so that neither the surface or depth hardness desired will be obtained. In addition, a thin scale condition is accompanied by formation of a decarburized bark which will materially reduce both wear and fatigue resistance if not removed. This decarburization is a serious disadvantage where tolerances do not permit the removal of additional metal from the surface, or where the shape of the item makes costs of removal prohibitive. A thin tight-adhering scale is generally the product of an atmosphere that is alternately oxidizing and reducing. In a hand-fired furnace, precautions are usually taken to insure an oxidizing atmosphere which will produce a loose scale easily removed by the quenching medium. Sandblasting, grinding or pickling are the usual methods of scale removal.

Decarburization is not as easily detectable as a scale formation. The effects of decarburized surfaces, however, are well known in the tool steel field, and many precautions are observed in an effort to minimize this condition. Repeated tests are made to determine the extent of decarburization. Machining, grinding or burning are used to remove decarburized bark.

Regardless of the type of operation necessary for removal of a scaled surface or a decarburized bark, the net result is a larger operational cost, stemming from the increased expenditure of materials and labor; the latter factor is the more significant one, especially at this time when labor cost is at its highest peak.

The decision as to whether it is more economical to contend with a scaled surface or a decarburized bark in preference to the utilization of preventive measures must be made in each plant. The decision must be based on a number of factors, such as the critical value of the item in question; cost of the additional labor and materials necessary for removal of the undesirable surface condition; equipment facilities; reliability of labor; and the nature of the labor market within the area. The last factor is of considerable importance now as it is becoming increasingly difficult to obtain unskilled labor who will work willingly on undesirable jobs such as manual grinding or pickling.

Generally, economic considerations make clear the advantages of some kind of preventive measure within the heating cycle. One of the more common ways of preventing an undesirable surface condition in the hardening and annealing of high-alloy tool steels is the use of the "pack method." The temperature usually employed in a case hardening procedure is between 1750 and 1850 F, a range in which considerable scaling and/or decarburization would normally occur during the heating cycle. Packing the steel in charcoal or clean cast iron chips, however, eliminates the oxidizing reaction at the metal surface. Principal objection to this type of protection is the high labor cost incurred from extensive loading and unloading of the "packs."

Carefully controlled atmospheres are another answer to the problem of protection, and one that practically eliminates the important labor factors from further consideration. A decision as to the advisability of providing a particular type of atmosphere control should be based on the following factors:

1. Geographical location of the plant. This will determine the type of heating required, *i.e.*, gas, oil or resistance heating. This selection will determine whether an auxiliary unit is required.

2. The specific operation and the production required. These will determine the type and size of furnace, capacity of atmospheric equipment, methods of handling the parts, etc.

3. The quality requirements of a specific part and the material from which it is to be manufactured. These will determine the heating cycle, the maximum temperature requirement for the specific operation involved, and any other precautionary measures that must be observed to insure a uniform product.

4. The cost of specialized furnace equipment along with the necessary auxiliary atmosphere unit as compared to the cost in both materials and man-hours of removing undesirable surface reaction products obtained in a conventional furnace installation without atmosphere control. This economic factor, of course, would be the deciding one.

Although a description of the many and varied types of furnace and atmosphere-generator installations available is beyond the scope of this manual, there are certain characteristics that are desirable features of any atmospheric unit selected:

1. The unit should be provided with sufficient gages so that the operating conditions of any specific installation can be easily determined at any time.

2. The equipment should be flexible enough to permit variation in the composition of the prepared atmosphere. This will allow necessary changes to be made to suit the individual atmospheric requirements of various types of materials.

3. The unit should be designed so that it can be shut off or started easily during intermittent production periods.

4. The generator should be designed so that the component parts can be readily reached in the ordinary maintenance operations necessary, such as oiling, cleaning, inspection, etc.

5. Once the equipment for atmosphere generation is installed and in operating condition, the simplicity of operation should be such that a minimum amount of attention is necessary.

6. The unit should be sufficiently large so that a constant flow of atmosphere at constant pressure conditions can be realized. In this connection, it is necessary to predetermine the probable loss of atmosphere during operation.

The loss of atmosphere during furnace charging and discharging of 6- to 8-in. drawn shells may be prohibitive for an expensive atmosphere such as ammonia or nitrogen. For smaller production items, as experienced in the sintering of metallic compacts, loss of atmosphere can be minimized and more expensive atmospheres utilized. If ammonia is selected for large items, it is well to consider purging

chambers whch add to initial cost of equipment but minimize loss and contamination of the atmosphere upon charging.

In the case of atmospheres designed to promote a surface reaction, the time factor can be important. Thus, in a nitriding operation, the cycle is rather long, and this factor must be considered so that furnace equipment of adequate size and quantity can be purchased.

Careful evaluation of these economic and technical factors will enable the individual to choose a unit that will produce the best quality work under a set of established conditions.

Characteristics of Industrial Controlled Atmospheres

Atmosphere	Source	Use	Materials	Advantages	Limitations
Hydrogen	1. Holders fed by electrolytic cells where water is dissociated into hydrogen and oxygen. 2. Bottles holding 220 or 440 cu. ft. S.T.P. compressed to 1800 to 2000 psi.	Bright annealing of narrow strip and strands. Sintering Brazing	High alloys (*e.g.* nickel-chromium steel), low-carbon steels, copper-nickel alloys, silicon iron. Metallic powders Low-carbon and stainless steels.	Reducing action.	1. Presence of impurities (water vapor and approx. 0.2% oxygen) in gas from electrolytic cell. 2. High cost of purified gas. 3. Difficulty in maintaining high purity in furnace chamber at operating temperatures.
Nitrogen	1. Air liquefaction plants 2. Bottles	Heat treatment Annealing Brazing	High-carbon steels Silicon iron, copper Copper or brass	1. Ability to add actively reducing gas to nitrogen atmosphere increases composite atmosphere gas control. 2. With concentration of active reducing gas held below 0.67%, gas mixture is non-explosive.	1. High cost of generation. 2. Oxygen and carbon dioxide must be removed from commercial nitrogen. Water can be removed mechanically. Oxygen must be combatted by inclusion of active reducing gas. 3. Cannot be used for bright work in large furnace installations because of difficulty of maintaining sufficient purity. 4. Nitriding and subsequent deterioration result from use of pure atmosphere with some resistor and heat resisting alloys, unless metal surface is protected by preformed oxide coating.
Ammonia Dissociated	Passage of ammonia through catalyst at high temperatures.	Bright annealing Bright silver and copper brazing Sintering Strain relief	Stainless steels, beryllium coppers Low-carbon steels Metallic powders Silicon iron	Substitute for hydrogen where maintenance of bright surface is imperative during heating cycle.	High nitrogen content may cause objectionable nitriding in sintering of molybdenum compacts and of powdered stainless steel containing small amounts of titanium or columbium.
Ammonia Partially combusted dissociated	Ignition of dissociated ammonia.	Bright annealing Bright silver and copper brazing Sintering	Low-carbon steels, copper-nickel alloys Low-carbon steels, stainless steels Copper, copper-lead and copper-tin alloys, graphite mixtures, low-carbon ferrous mixtures.	Cost considerably less than that of dissociated ammonia because of increased volume of gas atmosphere from unit quantity of ammonia resulting from dilution through combustion.	Auxiliary drying units sometimes necessary to lower dew point beyond room temperature for certain applications.
Ammonia Completely combusted dissociated	Same as above.	See Nitrogen	See Nitrogen	Relatively inexpensive substitute for nitrogen.	Impurities resulting from combustion must be removed by auxiliary equipment.
Fuel Gas Combusted — rich mixture (partially burned)	Ignition of propane, butane, natural or artificial gas.	Hardening or bright annealing where decarburization is not an important factor.	Ferrous materials	Relatively inexpensive generation per unit quantity.	1. Reducing properties sufficient to prevent scaling but not decarburization. 2. Combustion chamber temperature must be maintained high enough to prevent excessive formation of soot and oil vapors, but not so high as to cause formation of coke and heavy tar.
Fuel Gas Combusted — lean mixture	Same as above.	Bright annealing Brazing	Copper Copper and its alloys	Same as above.	Auxiliary units to remove sulfur must be provided.

(Continued on page 86)

Characteristics of Industrial Controlled Atmospheres—(Continued)

Atmosphere	Source	Use	Materials	Advantages	Limitations
Fuel Gas Reacted — rich mixture (partially reacted)	Catalytic cracking of fuel gas.	Hardening where decarburization must be avoided.	High-carbon, alloy and high-alloy steels.	Same as above.	Catalyst, *e.g.* nickel, required.
		Brazing	Ferrous metals (particularly high-carbon types).		
		Sintering	High-carbon and alloy compacts.		
		Carrier gas in gas carburizing.	Low- or medium-carbon steels.		
Fuel Gas Reacted — lean mixture	Same as above.	Hardening	Medium-carbon steels	Same as above.	Same as above.
		Sintering	Low- and medium-carbon steels, nonferrous metals (where long heating cycles are involved).		
Charcoal Generated	Air passed through hot bed of charcoal.	Carburization	Low- or medium-carbon steels.	Ideally suited to protection against scaling and/or decarburization in small installations.	1. Enrichment with propane or natural gas usually required for carburization. 2. Cost of operation dependent upon grade of charcoal used. 3. Difficulties experienced in large installations where generator tube must be rodded and hopper refilled frequently.
Diamond Block Generated	Decomposition of carbonaceous block in furnace.	Hardening	Tool steels containing cobalt or molybdenum.	No scale or decarburization.	Life of block about 50 heat treating hours.

Types of Atmospheres

After a definite cost analysis is made and the decision is to use a controlled atmosphere, it is then necessary to determine the type of atmosphere that will give the desired protection in the most economical manner.

In a discussion of the various types of controlled atmosphere units, it is well to consider the individual constituents resulting from combustion within the furnace chamber, as the composition of each gas will vary according to the type of equipment installed. The effects of the constituent gases upon steel at an average heat treating temperature, used in hardening or annealing operations, can be summarized as follows:

Oxygen reacts with the ferrite of steel to produce an iron oxide. It also reacts with the carbon in the steel to lower the surface carbon content, a reaction previously discussed as "decarburization." Most deleterious of the common gases, it should be completely eliminated in protective atmospheres.

Nitrogen in the molecular state is entirely passive to ferrite and is quite satisfactory for the bright annealing of low carbon steels. If bone dry and pure, it will also be passive to high carbon steels. However, the presence of mere traces of moisture will cause decarburization.

Carbon dioxide is reactive with ferrite and causes oxidation to occur. It can also be decarburizing in nature. Since the product of reaction, in either case, is carbon monoxide, its effect upon the steel surface can be counterbalanced by mixing it with a certain proportion of the latter gas. For low carbon steels, the ratio of carbon monoxide to carbon dioxide may be of the order of 2 to 1; for the higher carbon steels, and depending upon the temperature of the processing treatment, this ratio may be as high as 100 to 1.

Hydrocarbons, e.g. methane and propane, are carburizing gases. They are subject to thermal decomposition at the annealing temperatures, liberating hydrogen and depositing soot on the steel surface.

Carbon monoxide reacts with ferrite at the higher temperatures to form iron carbides. It is therefore carburizing and a desirable constituent in a protective atmosphere in the heat treatment of high carbon steels. At low temperatures it tends to break down with consequent formation of carbon dioxide and free carbon, which deposits on the steel surface as soot or carbon black.

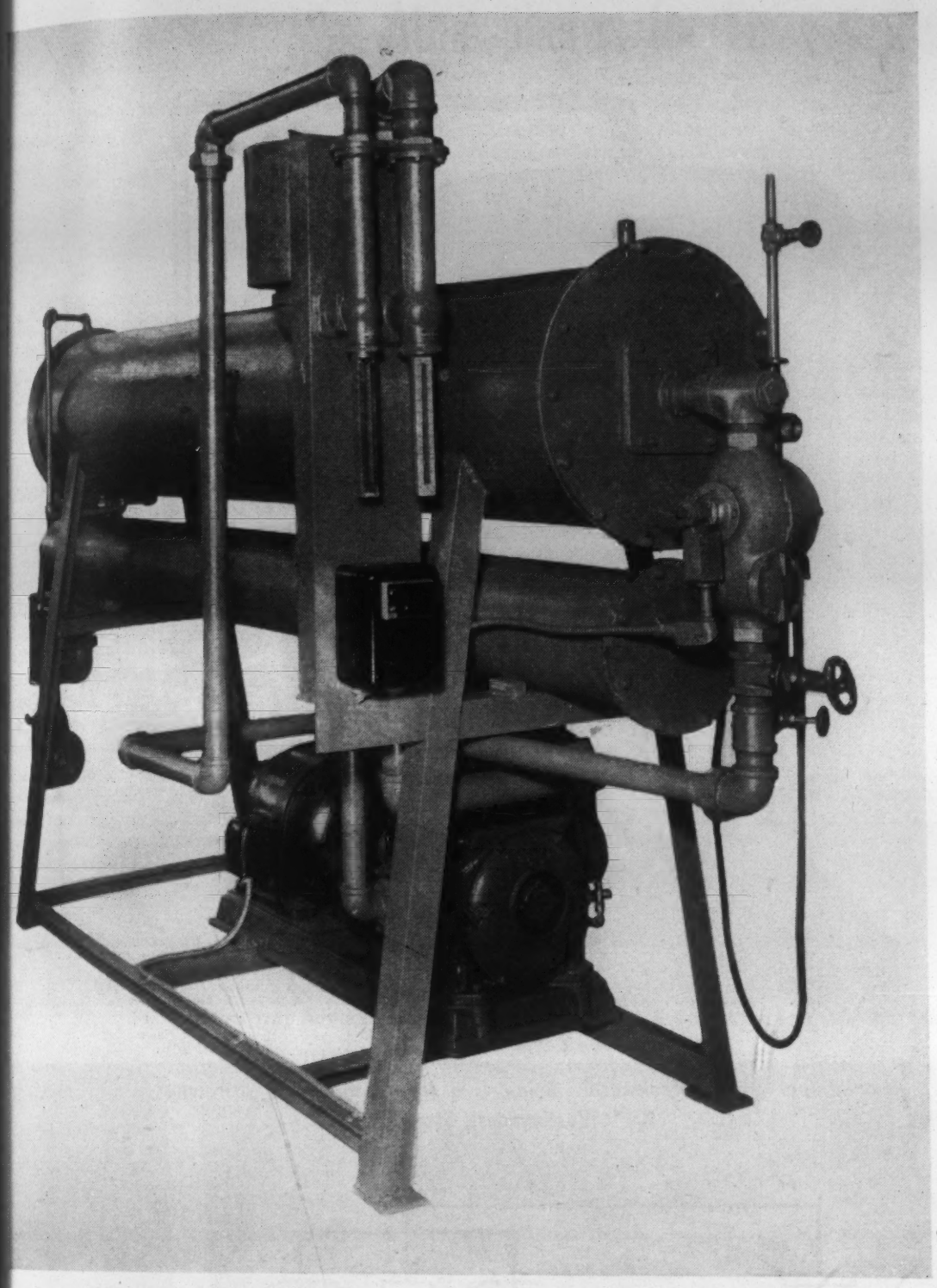
Hydrogen is highly reducing to iron oxide and is, therefore, classified as a powerful deoxidizer. At certain temperatures it is absorbed by the steel, either by occlusion or by direct combination with ferrite to form iron hydride. This condition is likely to result in embrittlement, especially in the high carbon steels. If bone dry, hydrogen has no decarburizing effect on high carbon steels except at elevated temperatures, where it reacts with the carbon to form methane.

Water vapor is oxidizing to ferrite and combines with the carbon in steel to form carbon monoxide and hydrogen. It reacts with steel surfaces at very low temperatures and is the principal cause of blueing during a cooling cycle.

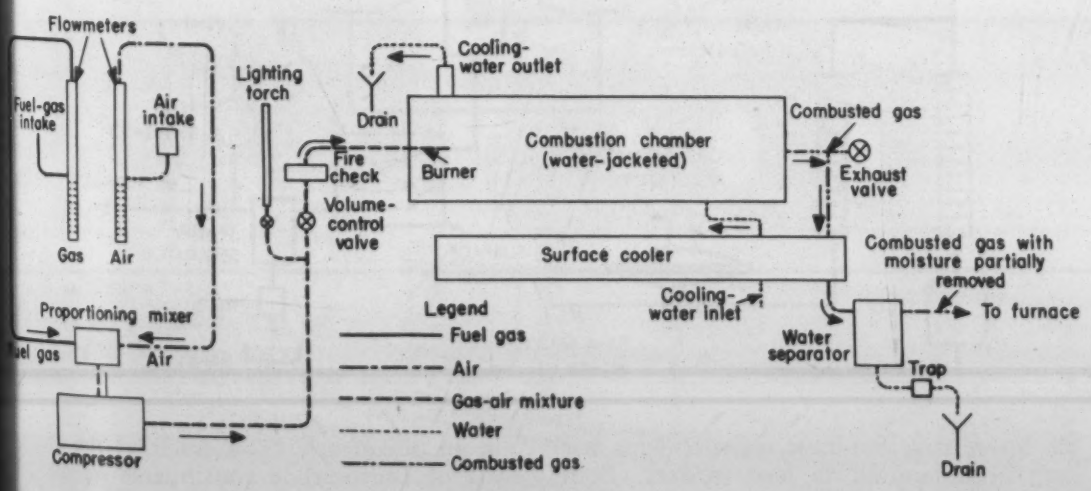
The engineer who is not well versed in the intricacies of controlled atmospheres might be confused by the variety of special atmospheres available for commercial use. From a technical and economic viewpoint, it is important to realize the nature of each atmosphere, its specific applications, and its peculiar advantages and limitations. The accompanying table summarizes these characteristics of the various industrial controlled atmospheres, classified according to the raw materials used in their generation. The principal atmospheres are hydrogen, nitrogen, dissociated ammonia, combusted fuel gas, and reacted fuel gas.

Although several large installations adjacent to electrolytic plants are using hydrogen atmospheres, generally its use has been limited to laboratories and comparatively small installations.

Removal of moisture from a hydrogen atmosphere can be accomplished by the condensing effect of top water, by refrigerant cooling, by use of a regenerative dry-



Combusted fuel gas type converter for reforming city gas, natural gas, propane or butane. Typical flow diagram is shown below. (Courtesy General Electric Co.)



ing system, or by a combination of refrigerant cooling and regenerative drying. Refrigerant cooling is generally adequate to reduce the dewpoint sufficiently for bright annealing. Use of the combined units will result in an atmosphere gas having a dewpoint as low as −100 F.

There are two methods available for removing oxygen from a hydrogenaceous atmosphere. In one method, the gas is passed over copper at a temperature between 1100 and 1200 F, the copper acting as a catalyst to convert the oxygen with hydrogen into water. Any traces of oxygen can then be removed by passing the gas over hot ferro-manganese, ferro-silicon, or ferro-titanium at 1650 to 1850 F. A more economical method is to pass the gas through a palladium catalyst purifier at room temperature, oxygen being removed in the form of water vapor. Hydrogen from a palladium catalyst purifer that has also been regenerative-dried for the removal of moisture is considered adequate for the bright annealing of high chromium alloys.

Commercial nitrogen is now being used in several large scale operations to achieve results that could not be obtained by the more common protective atmospheres such as combusted gas, reacted fuel gas, or dissociated ammonia. Generally, actively reducing gases are added to the nitrogen in an amount just sufficient to react with absorbed oxygen that may diffuse into the furnace chamber. The presence of as little as 0.05% water vapor, corresponding to a dewpoint of −20 F, is deleterious; water vapor should be mechanically removed.

By controlling the degree of combustion of dissociated ammonia, the nitrogen content can be varied from 76 to 99%, the gas becoming less reducing and more inert as the nitrogen proportion increases. Usually a dewpoint corresponding to room temperature is realized without any auxiliary drying equipment, but auxiliary units usually augment this type of installation in order to lower the dewpoint where required in a specific application.

In connection with the combusted fuel atmosphere, the term "combusted" indicates that sufficient heat is generated during the reaction so that the reaction can continue without the application of an external heat source. For this reason, the combusted atmosphere is often referred to as an "exothermic reactant atmosphere." The catalytic cracked atmosphere is an "endothermic reactant atmosphere" since it is necessary to supply heat from an outside source to continue its preparation.

In a combusted atmosphere, the air-gas ratio will determine whether partial or complete combustion occurs, and this, in turn, will determine the end composition of the atmosphere. In addition, the air-gas ratio selected to obtain a specific analysis of prepared atmosphere will vary according to the initial composition of the fuel gas utilized. (Note the accompanying graph showing the gas composition for various air-gas ratios used with propane.)

The partially combusted gas has a lower air-gas ratio and is known as a "rich" mixture, whereas a more fully combusted atmosphere has a higher air-gas ratio and is a "lean" mixture. The rich mixture is reducing in nature, with the oxidizing tendency increasing as the air-gas ratio increases. The properties of a completely burned atmosphere are naturally comparable to those of nitrogen, providing that carbon dioxide is removed from the former by regenerative wash towers.

The degree of cracking in catalytic-cracked fuel gas atmospheres is analogous to the degree of combustion in burned atmospheres; the partially cracked atmosphere has greater reducing properties than a completely cracked atmosphere. For both exothermic- and endothermic-produced atmospheres, the richer the fuel gas in Btu. content, the greater will be the air-gas ratio required to obtain an atmosphere of the same composition.

An atmosphere produced from a fuel gas such as propane and conditioned by the

use of metallic lithium and lithium salts is claimed to prevent either scaling or decarburization. With a properly controlled air-gas ratio, the resultant atmosphere can be used as a carburizing medium. The lithium is intended to remove the harmful effects of carbon dioxide and water vapor. The lithium cartridges used contain a small percentage of metallic lithium mixed with both the carbonate and chloride of lithium.

In a consideration of water vapor and oxygen as impurities, the amount of the constituent in the atmosphere is not the only factor; the cumulative effect of these impurities is also important. Thus, commercial nitrogen contains approximately 0.2% oxygen and traces of water vapor, the cumulative effect being oxidizing. In the generation of combusted fuel gas, not only is the H_2O/H_2 ratio of importance, but also the CO_2/CO ratio and its effect in counteracting the H_2O/H_2 ratio. Since the "dewpoint" of a gas is an expression of the amount of water vapor in the atmosphere, the dewpoint indicates the extent to which corrective measures should be taken to eliminate this impurity.

For any fixed set of conditions, such as shape and size of the material, chemical composition of the material, type of heat treatment required (including recommended times and temperatures), production requirements, etc., it is necessary to evaluate the various types of atmospheres commercially available on an economic basis. Among the factors which must be considered are: purchase and installation costs of all equipment necessary to perform the specific function and meet the required production; operating costs, including fuel, power, cooling water, reagent replacement, labor and maintenance, and fixed charges, amortization, etc.; efficiency of the atmosphere, *i.e.* atmosphere loss relative to the size and shape of the material to be heat treated; and evidence of results obtainable based on pilot lot runs.

Testing of Atmospheres

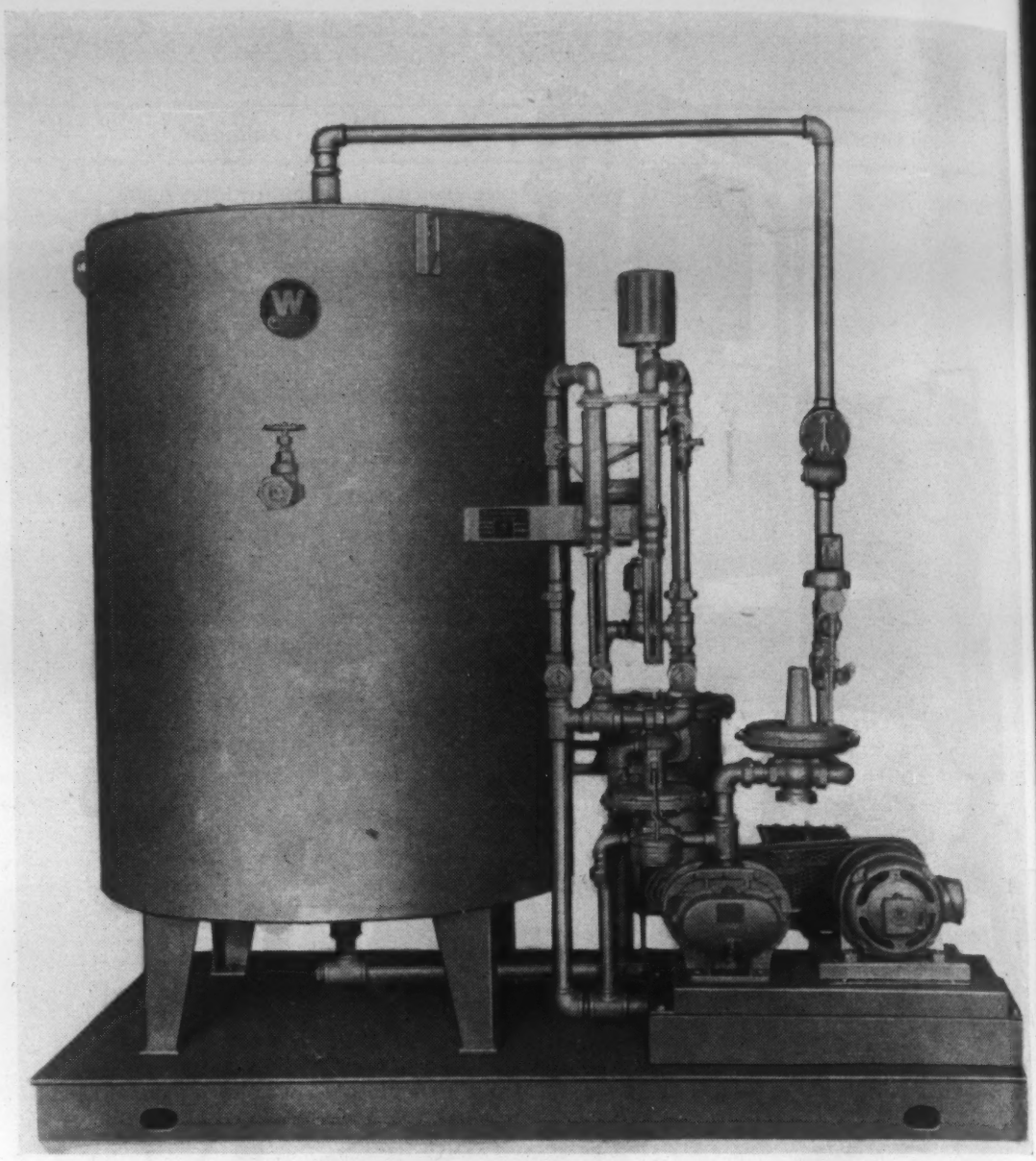
Technical evaluation of an atmosphere during an operational cycle or immediately afterward can be carried out in several ways: a metallographic check on test samples run through the standard procedure can be made; a chemical test can be used; a hardness survey can be made; or a sample can be evaluated on the basis of a weight difference.

The metallographic check is of more importance in those operations involving additive atmospheres rather than protective atmospheres. The use of the metallographic check on protective atmospheres is generally limited to scientific laboratory correlations of decarburizaion with an extended time period.

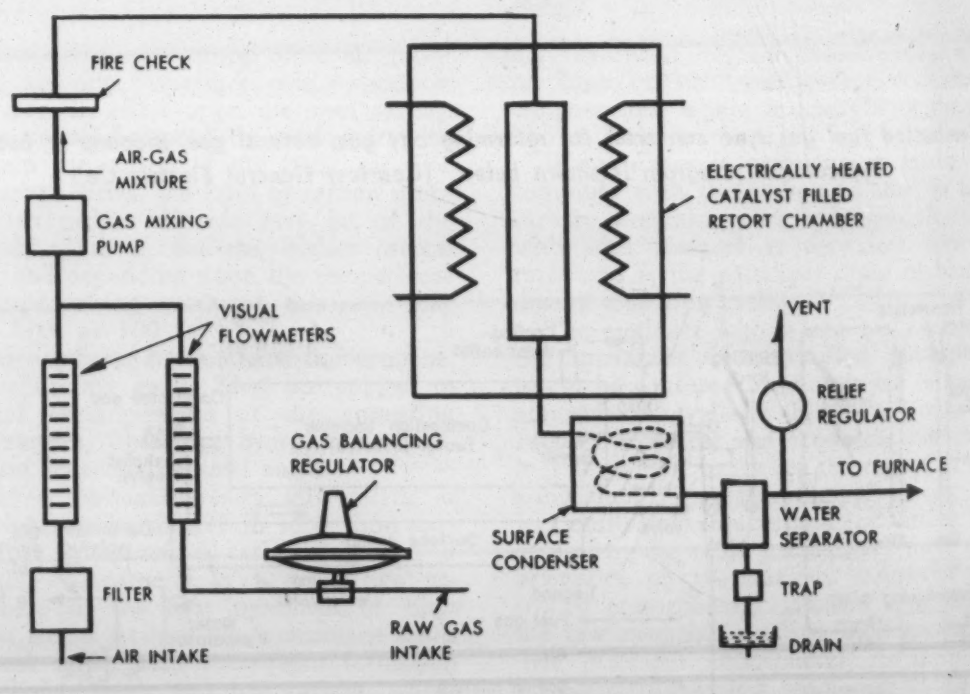
The chemical test is an accepted procedure in evaluating both the reactive and protective atmospheres. It consists of the removal of a pre-determined layer from which a sample for analysis is obtained. In the case of protective atmospheres, where the surface effect may be quite shallow in depth, the pre-determined cut may be too shallow to produce a quantity of chips sufficient for chemical analysis. In the investigation of hardened material, it might be difficult to obtain a machinable item without annealing. It is possible that the annealing practice might produce a surface reaction that would cloud the effect of the atmosphere being investigated.

The hardness test is by far the oldest method of evaluating atmospheres. Use of a file for relative hardness measurements has long been familiar to heat treaters. Both Rockwell and Brinell testing machines can be used to evaluate atmosphere effects.

The change in weight determination is the most reliable method and is quite accurate when limited to atmospheres that can be classified as scale-free. The slight discoloration on hardenable items obtained in an oil quench (as a result of the cracking of hydrocarbon constituents in the oil and the subsequent deposition of carbon on the surface) does not appreciably affect the results. Where cycles are relatively long, a proper evaluation can be obtained in a single production run, but in most cases it is necessary to run successive production cycles on the same sample.



Reacted fuel gas type converter. Below is a flow diagram for this type unit. (Courtesy Westinghouse Electric Corp.)



Atmospheres for Ferrous Metals

The types of industrial controlled atmospheres recommended for specific applications, additive and protective, for both ferrous and nonferrous metals are listed in tabular form in this manual. More important at the present time, of course, are those applications in the processing of steel.

The principal additive processes are carburizing, cyaniding, nitriding, and carbon restoration. The material usually used as the carburizing media is a hydrocarbon such as propane, which breaks down in the furnace into less complex hydrocarbons such as methane. The initial composition of the gaseous carburizing media will determine the rate of breakdown into the various constituents at the carburizing temperature. The addition of carbon is accomplished by the decomposition of carbon monoxide at the surface of the steel at the elevated temperature, followed by a diffusion procedure which results in a carbon gradient inward from the outside surface. An endothermic-produced gas or a gas from a charcoal generator can also be used for carburizing. Gas carburizing is widely practiced on small items where medium case depths are required.

A catalytic-cracked atmosphere is also used extensively in carbon restoration, *i.e.* restoring carbon to decarburized steel surfaces, by the principle of carbon pressure balances. By means of a controlled atmosphere of the desired carbon potential, carbon is transferred from the atmosphere to the decarburized surface until a carbon balance between the steel and the atmosphere has been obtained. At this point, the previously established inverse carbon gradient has been eliminated and the process stops automatically.

Either a catalytic-cracked or charcoal generated atmosphere can be applied to dry cyaniding. The dry cyaniding process utilizes both carbon and nascent nitrogen for case hardening, the resulting case being quite shallow in comparison to that obtained from pack hardening. The hardness is due to the production of innumerable carbides and nitrides within the case. As in gas carburizing, the active constituents are used in relatively small quantities and are diluted with a carrier gas which has substantially no effect upon either the reacting gas or the steel. Properly controlled, the reaction produces clean work, but carbon dioxide and water are particularly detrimental to a dry cyanide process and must be excluded from the carrier gas.

Nitriding is a surface reaction utilizing a nitrogenaceous media, commonly ammonia gas, to impart a high surface hardness to machined heat treated steel. Nitriding is carried out in a batch type furnace at 930 to 1000 F. The nitrogen produced from the dissociation of ammonia combines with the alloying elements in the steel to form nitrides. This fine dispersion of nitrides within the case provides the hard wear resistant surface. The resulting case depths are rather shallow compared to those produced by carburizing and cyaniding, but the skin hardness is much higher. An important disadvantage of nitriding is length of time required by complete cycle.

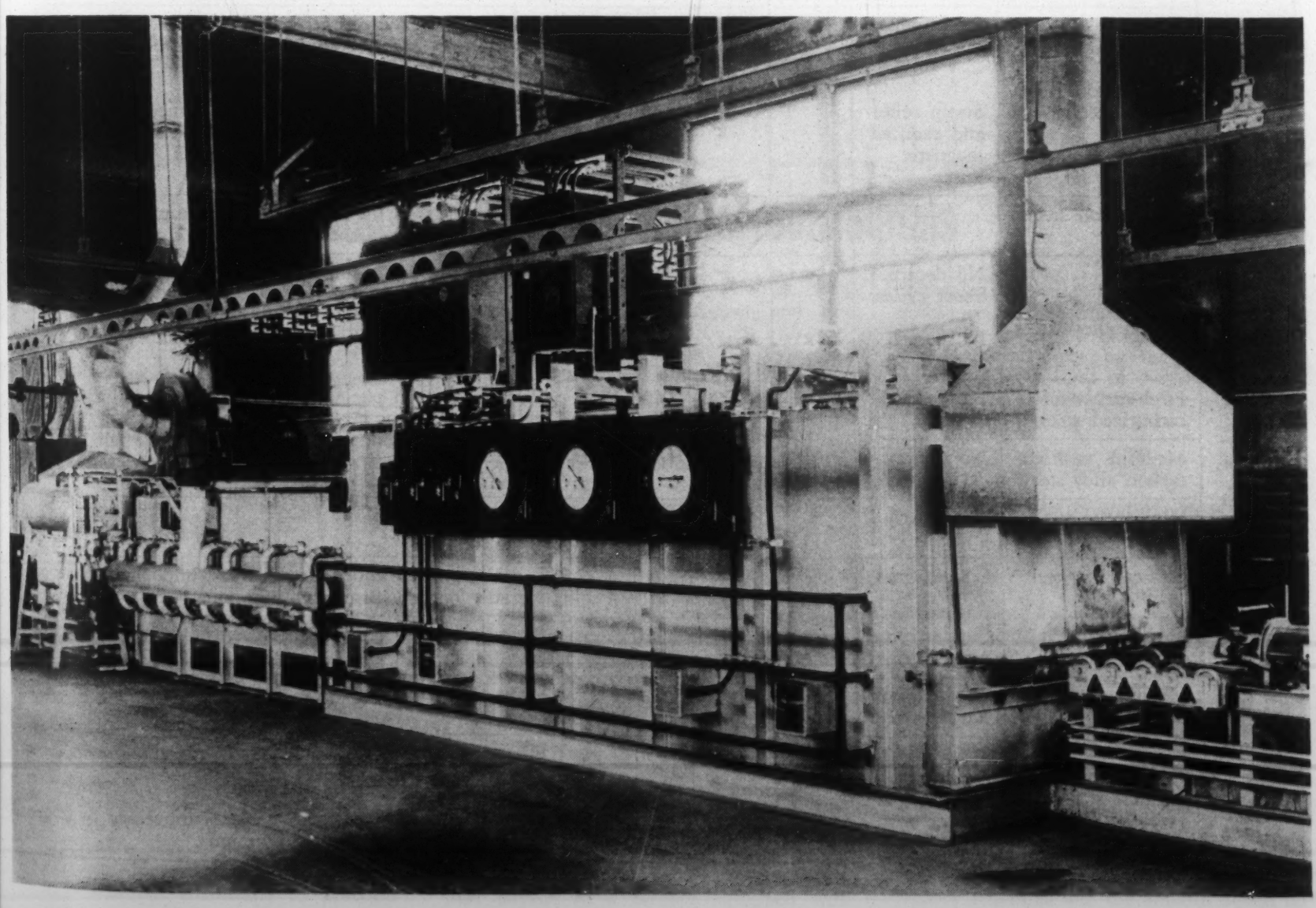
The importance of protective atmospheres in the control of surface reactions on steel has been discussed previously. The particular atmosphere required for bright annealing of steel varies with the metal composition.

A partially burned fuel gas is suitable for the bright annealing of low-carbon steels. This gas is approximately in equilibrium with steel having 0.20% carbon or less, and no measurable loss or gain in carbon occurs. In annealing motor lamination punchings made from low silicon steels, the completely burned fuel gas can be used as it produces a desirable film oxide on the surfaces of the laminations.

A gas chemically inactive, even for long cycles, is required for the bright annealing of medium- and high-carbon steels, as well as tool and high-speed steels. A completely burned fuel gas, with water and carbon dioxide removed, is used with no effect on the carbon content of the steel.

Only pure dry hydrogen is suitable for the bright annealing of stainless steels, although very little oxidation results from the use of burned fuel gas with water and carbon dioxide removed. Unpurified fuel gas can also be used without heavy oxidation, and burned dissociated ammonia is suitable provided that all traces of oxygen and water vapor are eliminated. Bright annealing must be done in alloy steel muffles constructed to prevent the entrance of oxygen, carbon dioxide and water vapor.

Pusher tray furnace with protective atmosphere for annealing iron castings. (Courtesy General Electric Co.)



Controlled Atmospheres Recommended for Specific Applications

Application	Material	Requirements: Metallurgical or Chemical	Metal Surface: Bright	Metal Surface: Clean	Temp. F	Atmospheres Recommended
Annealing	Low-carbon steels	—	x		1200-1350	Partially burned unpurified fuel gas, unpurified hydrogen, partially burned dissociated ammonia.
	Medium- or high-carbon steels	No decarb. Short cycles	x		1200-1450	Partially burned purified fuel gas, completely reacted fuel gas.
		No decarb. Long cycles	x	x	1200-1450	Near-completely burned purified fuel gas.
	Medium- or high-carbon alloy steels	No decarb. Short cycles	x	x	1300-1600	Partially burned purified fuel gas, completely reacted fuel gas.
		No decarb. Long cycles	x	x	1300-1600	Near-completely burned purified fuel gas.
	High-speed steels	No decarb. Short cycles		x	1450-1650	Partially burned purified fuel gas, completely reacted fuel gas.
		No decarb. Long cycles		x	1450-1650	Near-completely burned purified fuel gas.
	Stainless steels	—	x		1800-2100	Purified hydrogen, untreated dissociated ammonia.
				x	1800-2100	Partially burned unpurified fuel gas.
	Copper	—	x		500-1200	Completely burned unpurified fuel gas, purified nitrogen, unpurified carbon dioxide.
	Copper-nickel alloys	—	x		800-1400	Partially burned unpurified fuel gas, unpurified hydrogen, partially burned dissociated ammonia.
	Brasses and bronzes	—		x	800-1400	Completely burned unpurified fuel gas, near-completely burned purified fuel gas.
	Silicon iron (electrical sheets)	Strain relief		x	1450-2000	Unpurified cell hydrogen, unpurified nitrogen from air-liquefaction plant, completely burned purified fuel gas, untreated dissociated ammonia.
		Strain relief and reduced magnetic losses		x	1450-2000	Unpurified cell hydrogen, partially burned unpurified fuel gas (short cycles), untreated dissociated ammonia.
Normalizing	Low-carbon steels	—	x	x	1600-1850	Partially burned unpurified fuel gas, unpurified hydrogen, partially burned dissociated ammonia.
	Medium- or high-carbon alloy steels	No decarb. Short cycles	x	x	1500-2000	Partially burned purified fuel gas, completely reacted fuel gas.
		No decarb. Long cycles	x	x	1500-2000	Near-completely burned purified fuel gas.
Hardening	High-carbon or carburized steels	No decarb.	x	x	1400-1750	Partially burned purified fuel gas, completely reacted fuel gas.
	Medium- or high-carbon alloy steels	No decarb.	x	x	1400-1750	Same as above.
	High-speed tool steels	No decarb.	x	x	1800-2400	Same as above.
Brazing	Low-carbon steels	Copper braze	x		2050	Partially burned unpurified fuel gas, unpurified hydrogen, partially burned dissociated ammonia.
	Medium- or high-carbon steels	Copper braze No decarb.	x		2050	Partially burned purified fuel gas, completely reacted fuel gas.
	Medium- or high-carbon alloy steels	Copper braze No decarb.	x		2050	Same as above.
	Stainless steels	Copper braze No flux	x		2050	Purified hydrogen, untreated dissociated ammonia.
		Copper braze With flux		x	2050	Partially burned unpurified fuel gas, unpurified hydrogen, partially burned dissociated ammonia.

(Continued on next page)

Controlled Atmospheres Recommended for Specific Applications—(Continued)

Application	Material	Requirements: Metallurgical or Chemical	Metal Surface: Bright	Metal Surface: Clean	Temp. F	Atmospheres Recommended
Brazing (cont'd)	Cast iron	Silver braze With flux		x	1100-1600	Same as above.
	Medium- or high-carbon steels	Silver braze With flux		x	1100-1600	Partially burned purified fuel gas, completely reacted fuel gas.
	Copper or brass	Silver braze With flux		x	1100-1600	Completely burned fuel gas, unpurified nitrogen.
Sintering	Low-carbon ferrous metals	Sintering	x	x	1800-2100	Partially burned unpurified fuel gas, unpurified hydrogen, partially burned dissociated ammonia.
	Medium- or high-carbon ferrous metals	Sintering No decarb.	x	x	1800-2100	Partially burned purified fuel gas, completely reacted fuel gas.
	Nonferrous metals; copper, copper-lead, copper-tin-graphite, etc.	Sintering	x	x	1300-1900	Partially burned unpurified fuel gas, partially burned dissociated ammonia.
	Tungsten	Sintering	x	x	2150-2500	Purified hydrogen, untreated dissociated ammonia.
	Alnico magnets	Sintering	x	x	2150-2500	Same as above.
	Molybdenum	Sintering	x	x	2150-2500	Purified hydrogen.
	Stainless steels (containing titanium or columbium)	Sintering	x	x	2150-2500	Purified hydrogen.
Gas Carburizing	Low-carbon steels	Carburizing		x	1600-1750	Natural gas or propane, partially burned purified fuel gas (carrier gas enriched with natural gas or propane), completely reacted fuel gas (enriched).
Carbon Restoration	Medium- or high-carbon steels, plain and alloyed	Carburizing		x	1500-1650	Partially burned purified fuel gas, completely reacted fuel gas.
Nitriding	Alloy steels (Nitraloys)	Nitriding		x	1000	Ammonia.

Adapted from "The General Electric Review", Nov. 1948

Atmospheres for Nonferrous Metals

As indicated in these tables, the applications of protective atmospheres to nonferrous metals such as copper, magnesium, zinc, and their various alloys are becoming increasingly important as the consumption of formed light-metal alloys increases. Additive atmospheres, on the other hand, have no application in the field of nonferrous metals.

Copper-Base Alloys

It is possible to anneal copper-base alloys with a bright scale-free surface under an exothermically produced atmosphere. However, the atmosphere must be purified to insure satisfactory results, especially when it is high in sulfur. Sulfur contamination of the atmosphere will result in attack of the surface finish and pronounced staining. This type of staining can be removed by immersing the piece in dilute sodium or potassium cyanide, but the poisonous effects of these solutions make this bad practice. Sulfur dioxide can be removed from the atmosphere gas by passing it through a water scrubbing tower, and hydrogen sulfide is removed chemically by reaction with iron oxide impregnated shavings. Both electrolytic tough pitch copper and deoxidized copper are susceptible to hydrogen embrittlement, an excess of 1% hydrogen being sufficient to cause trouble. Free oxygen, even in very small amounts, is also harmful.

The sensitivity of the copper-base alloys to hydrogen, oxygen, and hydrogen sulfide is dependent upon the composition of the particular alloy. Thus, the silver-containing copper alloys are more sensitive to hydrogen and hydrogen sulfide in the atmosphere than are the copper-nickel alloys. Because of the extreme sensitivity of the copper-silver alloys, an atmosphere of steam is often employed. In the copper-zinc alloys, not only oxygen, but also water vapor and carbon dioxide, are harmful to the surface appearance. Both carbon dioxide and water vapor must be removed from an atmosphere used in annealing copper-zinc alloys.

One advantage in using a properly conditioned atmosphere for the annealing of copper-base alloys is freedom from fire cracking, despite the lack of any pre-heating operation. This effect is due to the slower heat transfer, and consequently less drastic heat effects, in a furnace equipped with atmosphere control. In addition, the material can be held much longer at a specified annealing temperature, permitting the use of lower annealing temperatures and thereby closer control of the physical properties of the annealed piece.

Aluminum and Its Alloys

In heat treating procedures for aluminum and its alloys, the temperatures employed are low compared to those for ferrous and copper alloys. However, the temperatures may vary from 250 F for a precipitation treatment to 950 F for a solution heat treatment, and close temperature control is essential.. The most harmful atmospheric constituents are water vapor, sulfur dioxide and ammonia. Moisture and sulfur compounds cause blistering and high temperature oxidation. The protective compound Alorco, added to a normal furnace atmosphere at the operating temperature, will combat the effect of moisture resulting from high humidity and will control sulfur to some extent. As this treatment is repeated, the furnace refractories retain some of the vapors generated and the amount added on

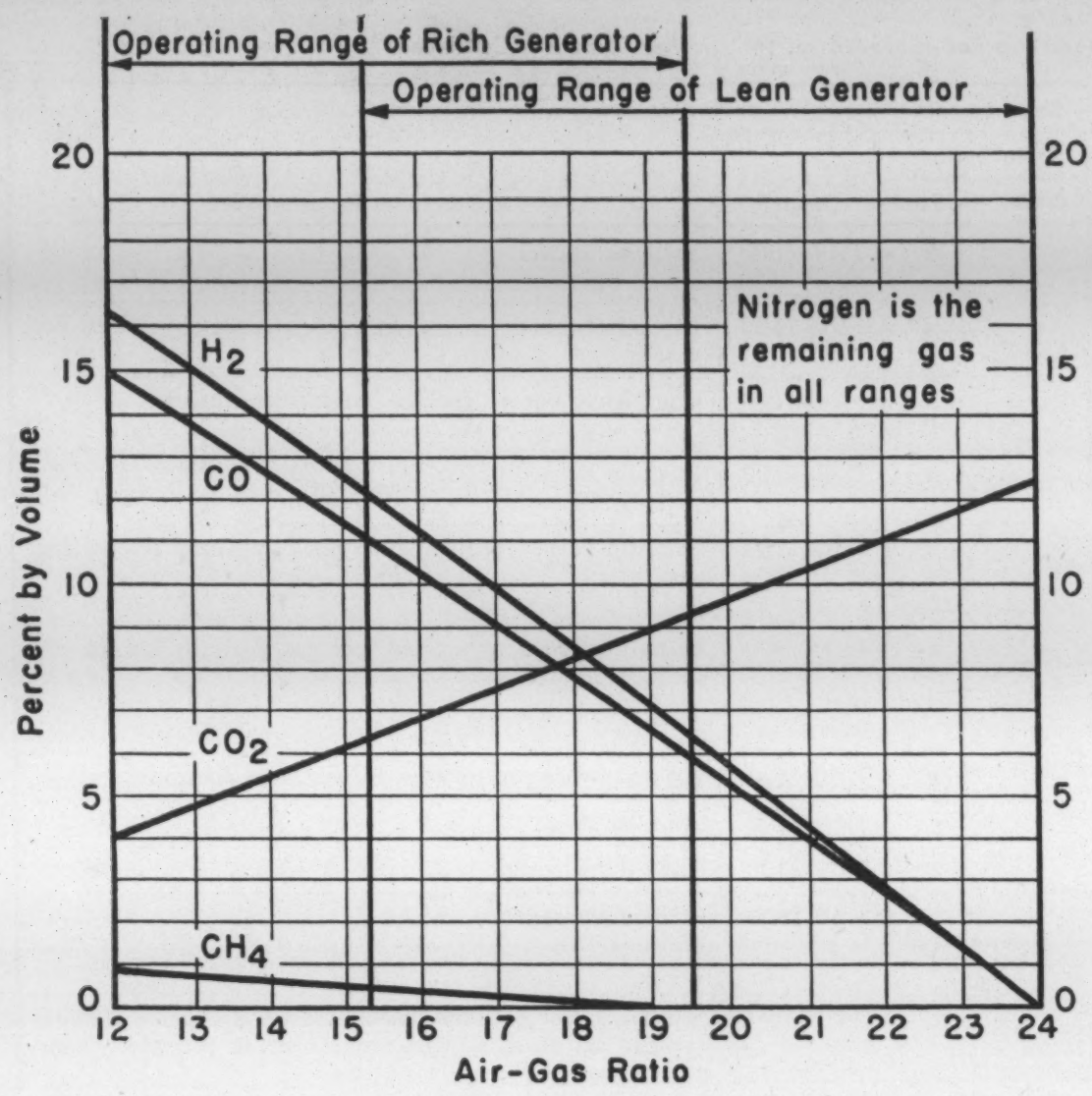


Chart giving air-gas ratio in atmospheres produced by combustion of propane. (Courtesy Westinghouse Electric Corp.)

subsequent loads becomes smaller. A complete air recirculating furnace responds much better to the action of this compound than one in which the combustion products sweep through and carry away the vapors generated.

Magnesium

In considering magnesium with respect to controlled atmospheres, it is well to note certain important differences between this material and other common metals:

1. Under certain circumstances, the reaction of magnesium with a normal atmosphere is excessive.
2. There are no carburization, decarburization or similar sub-surface equilibrium reactions that require specific atmosphere balances.
3. Heat treating temperatures are relatively low.
4. The presence of low melting compounds or eutectics in most "as cast" magnesium alloys may necessitate a multi-step or gradient temperature treatment in order to obtain maximum physical properties without damage from local fusion or oxidation.

A concentration of from several tenths to 1% of sulfur dioxide has been found to be the best protective medium for magnesium. The exact concentration does not appear too critical, but it is essential that a continuous supply of fresh gas be admitted to balance any possible leakage. An air recirculating type furnace is usually preferred. Sulfur dioxide produces a transparent crystalline film on magnesium parts; apparently this film is not harmful and it can be removed easily by subsequent pickling or sand blasting.

Helium, argon and other inert gases are satisfactory for protecting magnesium although high cost limits their use. These gases do not inhibit oxidation but rather replace oxidizing gases. Hydrogen, raw hydrocarbon gases, ammonia and carbon monoxide will protect magnesium, but these gases are all quite dangerous to handle. Nitrogen, usually considered an inert gas, will react with magnesium. Dehydrated combustion gases are generally satisfactory at normal heat treating temperatures. The addition of sulfur dioxide to combustion atmospheres is of doubtful value, particularly if they have not been dehydrated, as acid vapors are formed and corrosion of furnace parts and control devices results.

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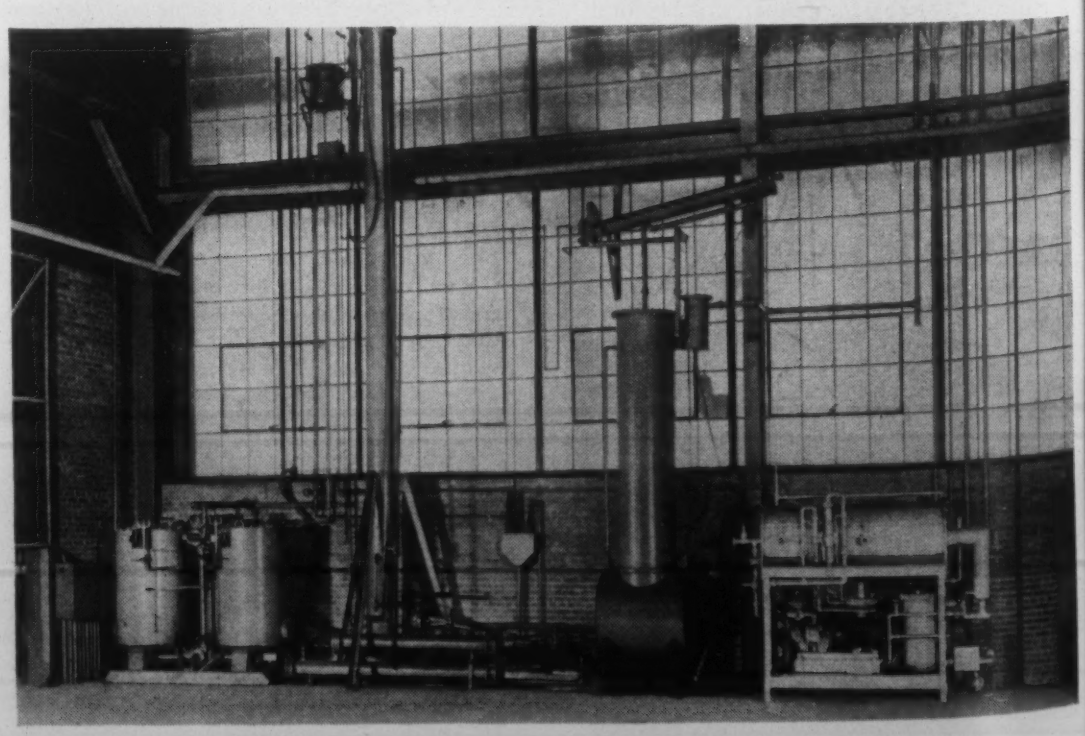
W. F. Ross, "Non-Ferrous Annealing in Controlled Atmospheres," *Metal Industry,* Feb. 1938.

S. Tour, "Furnace Atmosphere Generation," Trans. Am. Soc. for Metals, Vol. 29, 1940.

S. Tour, "Water Vapor in Furnace Atmosphere," Trans. Am. Soc. for Metals, Vol. 29, 1940.

"Westinghouse Heat Treating Atmospheres," Westinghouse Electric Corp., East Pittsburgh, Pa.

Typical set-up of atmosphere equipment, consisting of an exothermic generator, wash towers, alumina tower and refrigerant unit. (Courtesy Westinghouse Electric Corp.)



Materials Engineering File Facts

NUMBER 180
October, 1949

Magnesium Casting Alloys

Typical Properties

MATERIALS DATA SHEET

Property	ASTM Am. Mag. Corp., Dow Chem. Co.	AZ 63 AM 265, H	M 1 AM 403, M	AZ 92 AM 260, C	A 10 AM 240, G	AZ 91 AM 263, R
COMPOSITION, %		Al, 5.3-6.7 Zn, 2.5-3.5 Mn, 0.15 min.	Mn, 1.20 min.	Al, 8.3-9.7 Zn, 1.6-2.4 Mn, 0.10 min.	Al, 9.3-10.7 Zn, 0.3 max. Mn, 0.10 min.	Al, 8.3-9.7 Zn, 0.4-1.0 Mn, 0.13 min.
PHYSICAL PROPERTIES						
Density, Lb./Cu. In.		0.067	0.064	0.066	0.066	0.066
Melting Temp. Range, F		850-1135	1200	830-1100	865-1100	875-1105
Thermal Cond., Btu./Hr./Sq. Ft./Ft./°F, (212-572 F)		43.5	72.6	41.1	40.7	41.1
Coeff. of Exp., per °F: 65 to 212 F		1.4×10^{-5}	1.4×10^{-5}	1.4×10^{-5}	1.4×10^{-5}	1.4×10^{-5}
65 to 750 F		1.6×10^{-5}	1.6×10^{-5}	1.6×10^{-5}	1.6×10^{-5}	1.6×10^{-5}
Spec. Ht., Btu./Lb./°F (78 F)		0.25	0.25	0.25	0.25	0.25
Elect. Res., Microhms/Cm./Cm.^{2}:						
As Cast		11.5	6.6	15.0	15.0	17.0
Sol'n. Treated		14.0	—	17.0	17.5	—
MECHANICAL PROPERTIES						
Modulus of Elasticity		6.5×10^6	6.5×10^6	6.5×10^6	6.5×10^{-6}	6.5×10^6
Tensile Str., 1000 Psi.:						
As Cast		29.0	14.0	24.0	22.0	36.0
Sol'n. Treated		40.0	—	40.0	40.0	—
Sol'n. Treated & Aged		40.0	—	40.0	40.0	—
Yield Str., 1000 Psi.:						
As Cast		14.0	4.5	14.0	12.0	23.0
Sol'n. Treated		14.0	—	14.0	13.0	—
Sol'n. Treated & Aged		19.0	—	22.0	19.0	—
Elongation, % (in 2 In.):						
As Cast		6	5	2	2	4
Sol'n. Treated		12	—	10	10	—
Sol'n. Treated & Aged		5	—	2	1	—
Compressive Yield Str., 1000 Psi.:						
As Cast		14.0	4.5	14.0	12.0	23.0
Sol'n. Treated		14.0	—	14.0	13.0	—
Sol'n. Treated & Aged		19.0	—	23.0	19.0	—
Hardness, Bhn.:						
As Cast		50	33	65	53	60
Sol'n. Treated		55	—	63	52	—
Sol'n. Treated & Aged		73	—	83	69	—
Shear Str., 1000 Psi.:						
As Cast		18.0	11.0	19.0	18.0	20.0
Sol'n. Treated		19.0	—	20.0	20.0	—
Sol'n. Treated & Aged		21.0	—	21.0	22.0	—
Fatigue Str. (End. Limit), 1000 Psi.:						
As Cast		11.0	—	11.0	10.0	14.0
Sol'n. Treated		14.0	—	14.0	11.0	—
Sol'n. Treated & Aged		13.0	—	13.0	10.0	—
Impact Str. (Izod) Ft.-Lb.:						
As Cast		3	9	1	2	2
Sol'n. Treated		5	—	4	4	—
Sol'n. Treated & Aged		2	—	1	2	—
THERMAL TREATMENT						
Solution Temp., F		730	—	760	790	—
Aging Temp., F		375	—	420	400	—
Stabilizing Temp., F		500	—	500	500	—
FABRICATING PROPERTIES						
Casting Temp., F: Sand		1350-1550	1350-1550	1350-1550	1350-1550	—
Chill		1200-1500	—	1200-1500	1200-1500	1150-1250
Weldability:* Torch		D	A	D	D	—
Inert Arc		D	A	A	A	—
Elect. Res.		A	A	A	A	—
Machinability Index (Free-Cutting Brass = 100)		500	500	500	500	500
CORROSION RESISTANCE						
Resist. to Atmosphere		Good	Good	Good	Good	Good
Resist. to Salt Water*		B	A	B	D	B
USES		Sand castings	Sand castings	Sand & perm. mold castings	Sand & perm. mold castings	Die castings
		Parts for aircraft landing wheels and reciprocating and jet type engines, vacuum cleaners, portable grinders and drills, foundry flasks, textile machinery, pistons, and various fittings, brackets and covers.				

* *Letter A indicates most favorable property, D least favorable, etc.*

Prepared with the assistance of American Magnesium Corp. and Dow Chemical Co.

MAINTENANCE CUT

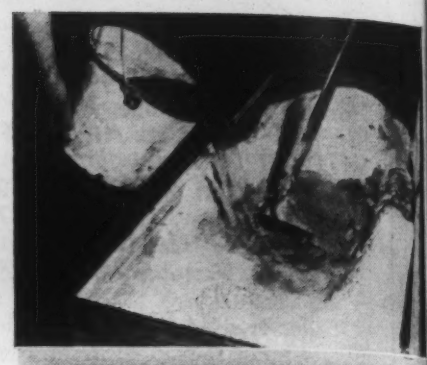
Several Thousand Dollars Per Year with **KAOCAST**

Photographs courtesy Ford Motor Company

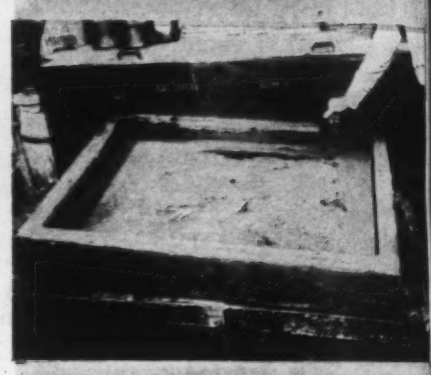
A large automobile manufacturing firm found that high temperatures and severe operating conditions were playing havoc with the doors of their 15-ton electric furnaces. Run 16 hours a day, 5 days a week, these furnaces are poured every 2½ hours and are charged twice during each cycle. With a good grade of firebrick, furnace door linings lasted an average of only two or three days before replacements were necessary.

A trial installation of KAOCAST—the B&W high temperature Refractory Castable—was made. The KAOCAST doors stood up two to three weeks . . . *five to eight times longer than firebrick.* As a result, doors on all electric furnaces of this type are now lined with KAOCAST. *Savings in maintenance are running into thousands of dollars per year.*

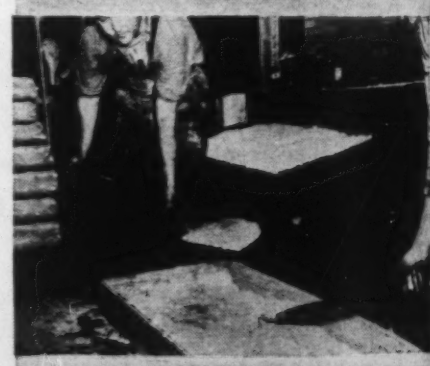
Your B&W Refractories Engineer will be glad to show how KAOCAST will cut your furnace operating cost. Write or call him today.



KAOCAST, easy to use as ordinary concrete, can be mixed in mortar box or concrete mixer.



Shell of furnace door, cleaned, ready for installation of KAOCAST.



Shoveling KAOCAST into place. KAOCAST can also be poured like ordinary concrete, plastered in place, or applied with a cement gun.

B&W REFRACTORIES PRODUCTS

B&W 80 FIREBRICK • B&W JUNIOR FIREBRICK
B&W 80 GLASS TANK BLOCKS • B&W INSULATING FIREBRICK
B&W REFRACTORY CASTABLES, PLASTICS AND MORTARS

•

OTHER B&W PRODUCTS

Stationary & Marine Boilers and Component Equipment
Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers
Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: AUGUSTA, GA.

B-339

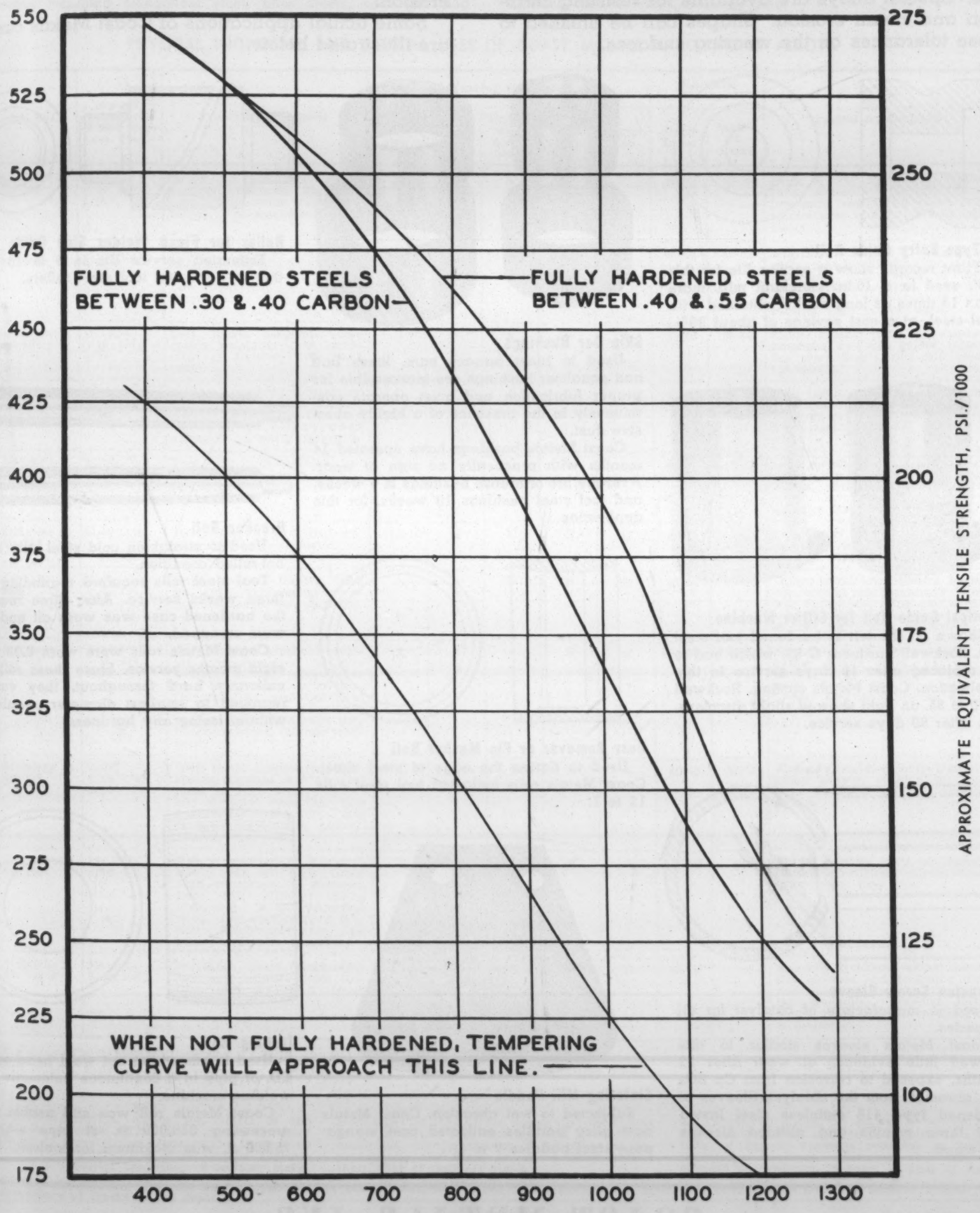
Materials Engineering File Facts

NUMBER 181
October, 1949

MATERIALS: Steel

Relationship Between Hardness Tempering Temperature

Carbon and Alloy Steels, Including Series 1000, 1300, 3100, 3200, 4100, 2300, 4600, 5100 and 6100



Courtesy General Motors Corp.
(from "General Motors Standards")

COAST METALS

hard castings . . .

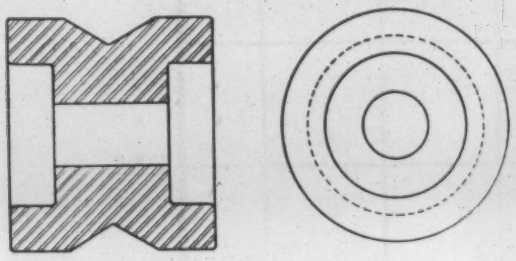
Coast Metals Alloys in cast shapes resist wear 5 to 10 times better than hardened tool steels.

These alloys consist of complex carbides having a high micro-scratch hardness embedded in a tough austenitic matrix to resist shock. They retain their wear hardness at high temperatures, have a low coefficient of friction, and acquire a high polish in use. Special alloys are available for resisting corrosion and steam erosion. Shapes can be finished to close tolerances on the wearing surfaces.

Coast Metals castings are used in cold and hot steel mill operations, specific shapes including guide rollers, bushings, sleeves, edging rolls, leveler rolls, scale breaker rolls, idler rolls, cold-forming rolls and hot bar mill guides.

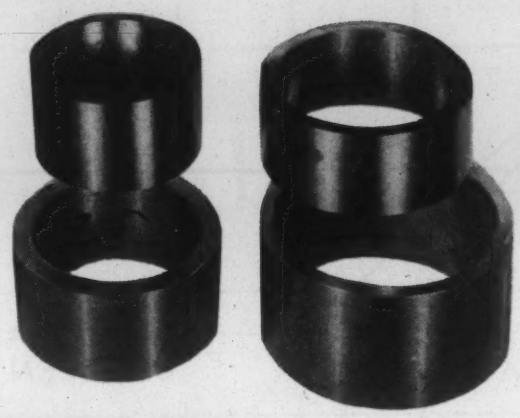
They are also used in other industries to resist wear caused by abrasion, corrosion, heat, and erosion.

Some actual applications of Coast Metals castings are illustrated below.



V-Type Entry Guide Roll

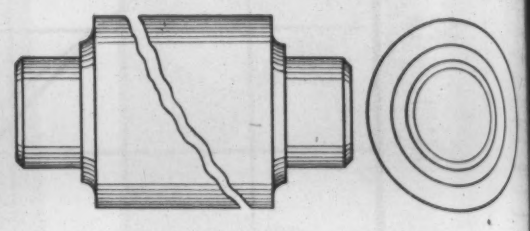
Plant records show a service life for this roll, used in a 10-in. merchant mill, more than 15 times as long as that obtained with tool steel, at a cost savings of about 80%.



Skip Car Bushings

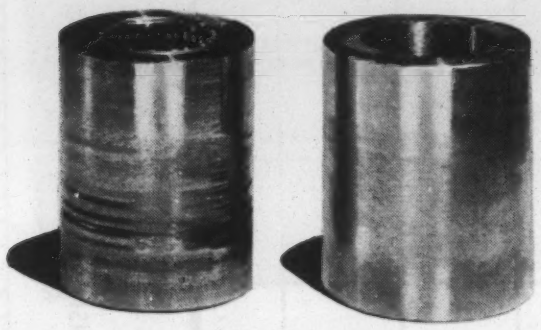
Used in blast furnace cars, these bail and equalizer bushings are inaccessible for proper lubrication and must operate continuously in the presence of a highly abrasive dust.

Coast Metals bushings have operated 14 months with practically no sign of wear. Average life of bronze bushings is 6 weeks, and tool steel bushings 10 weeks, for this application.



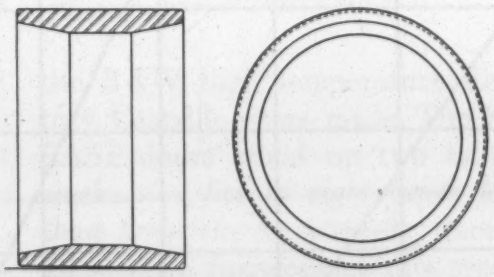
Roller for Flash Welder Side Guide

Estimated service life is 5 to 10 times that of hardened tool steel rollers.



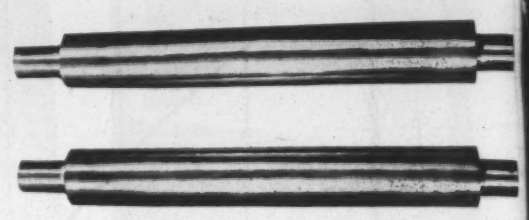
Vertical Guide Roll for Slitter Machine

Shown on the left is hardened tool steel roll, Rockwell hardness C 62, which had to be replaced after 10 days service in this application. Coast Metals casting, Rockwell C 50 to 55, on right showed slight discoloration after 90 days service.



Burr Remover or Fin Masher Roll

Used to flatten the edge of steel sheet. Coast Metals rolls outlasted tool steel rolls 12 to 1.

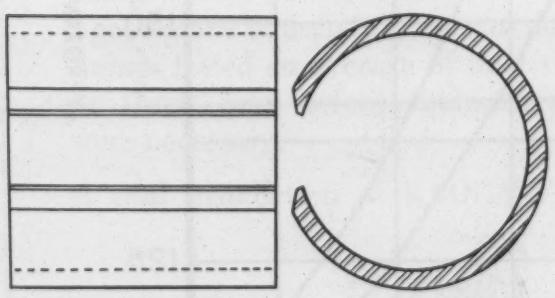


Breaker Roll

Used to straighten cold steel strip in the hot-rolled condition.

Tool steel rolls required regrinding after three weeks service. After three regrinds, the hardened case was worn off and rolls were scrapped.

Coast Metals rolls were worn 0.02 in. in eight months service. Since these rolls are uniformly hard throughout, they can be reground to smallest diameter permissible without losing any hardness.



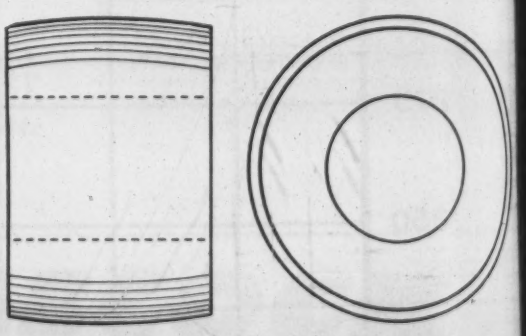
Extrusion Screw Sleeve

Used in manufacture of catalyst for oil refineries.

Coast Metals sleeves similar to this showed little evidence of wear after 32 months, exposed to corrosion from Cu SO_4 and abrasion from the catalyst. Sleeves of hardened type 416 stainless steel lasted only three months and nitrided sleeves one month.

Sintering Mill Paddle

Subjected to wet abrasion, Coast Metals cast alloy paddles outlasted cast manganese steel paddles 7 to 1.



Ironing Roll

Used in smoothing out weld bead on the I.D. of pipe in a continuous automatic pipe welding machine.

Coast Metals roll was still usable after processing 350,000 ft. of pipe whereas 75,000 ft. was maximum for toolsteel rolls.

COAST METALS, INC.

1232 CAMDEN AVENUE S.W., CANTON 6, OHIO

Coast Metals, Inc.

Materials Engineering File Facts

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NUMBER A-3
October, 1949

COAST METALS HARD-FACING ALLOYS

MATERIALS: Wear Resistant Overlays

Coast Metals are patented alloys of uniform and accurately controlled composition. Possessing a wide range of properties to meet the demands of severe service, they withstand mechanical wear, abrasion, impact, shock, corrosion and heat.

Coast Metals hard-facing alloys can be welded to all ferrous metals including manganese steel, alloy steels, cast iron and chilled iron. They can be applied by acetylene or arc welding, coated rods being used in the arc process.

The table below lists properties and uses of Coast Metals hard-facing alloys. More specific information on use of Coast Metals Welding Rods may be obtained from Coast Metals, Inc., 1232 Camden Ave., S. W., Canton 6, Ohio.

PHYSICAL PROPERTIES AND TYPICAL USES OF COAST METALS HARD-FACING ALLOYS

Rod Nos.	Identification Color & Rod Sizes (in. dia.)	Properties of Deposit	Wearing Properties					Rockwell Hardness		Typical Applications
			Abrasion	Abrasion with Impact	Impact with Abrasion	High Temp.	Corrosion	Single Layer	Multiple Layer	
Acetylene 1 Arc 101	Yellow, 3/16, 1/4, 5/16	Tough, file-hard. Good wear, abrasion resistance. High impact. Machinable (see note below). Non-magnetic.	B	B	A	C	C	42-52	42-55	Brick & clay machinery, muller tires. Agriculture & agricultural processing equipment. Steel mill applications (Cold). Oilfield tool joints.
Acetylene 4 Arc 104	White, 3/16, 1/4, 5/16	Dense, abrasion resistant. Acetylene deposits on cylindrical sections without checks. Low coefficient of friction. Magnetic.	A	C	C	C	C	55-60	57-62	Shafting, centerless grinder rests, cams, gage blocks. Forming stainless steel cold. Sand & shot blast wearing plates, sheaves, pinch rolls, pipe bends, in fluid catalyst high octane units.
Acetylene 7 Arc 107	Orange, 3/16, 1/4, 5/16	Soft, tough. Generally corrosion resistant. Low coefficient of friction. Non-magnetic.	B	B	A	B	B	30-40	35-45	Cinder crusher rolls, chip crusher hammers, rail mill guides, classifier screw-flights, pug mill reactor shafts.
Acetylene 8 Arc 108	Blue, 3/16, 1/4, 5/16	Superb welding properties. Can be heat treated without damage. Machinable (see note below). Excellent edge strength. Slightly magnetic.	C	C	A	C	D	40-47	45-53	Cold trimming, stamping, punching. Paper stripper & tin shredding knives, flash trimmer knives, wood-working knives.
Acetylene 9 Arc 109	Silver. 3/16, 1/4, 5/16	Free from large carbides. Resists corrosion from H_2SO_4. Magnetic.	B	C	C	B	A	45-50	47-55	Hot piercing mill shoes, high speed or finishing steel mill guides. Extrusion screws where H_2SO_4 involved along with fine abrasive materials.
Acetylene 10 Arc 110	Green tip	Hard. Moderately high temp. properties. Non-magnetic.	A	B	C	B	D	48-56	52-60	Large steel mill guides, hot slag handling, coke plant equipment, stripper tong bits.
Arc 112 only	Red, 3/16, 1/4, 5/16	Hard, tough. Harder than No. 101. Outstanding abrasion resistance. Non-magnetic.	A	A	B	B	D	52-57	53-59	Digger teeth, jaw crushers, bucket lips, cement mill machinery, hammer mills, excavating equipment, sand & shotblast equipment. Coal & coke pulverizing equipment.
Acetylene 15 Arc 115	No color, 3/16, 1/4, 5/16	Hard, tough, excellent welding characteristics. Readily weldable without cross-checking. High temp. properties. Outstanding resistance to abrasion, impact. Excellent edge-strength. Generally corrosion-resistant. Slightly magnetic.	A	A	A	B	C	53-58	55-60	Sprocket teeth, valve ends & cams, mixer rolls, extrusion screws, high velocity hammer mills, sand & shot blast wearing plates. Grit blast nozzles, dredge bucket teeth.
Acetylene 18 Arc 118	Gold, 3/16, 1/4, 5/16	High temp. properties. Withstands constant and repeated loads at high temp. Generally corrosion resistant. Low coefficient of friction. Machinable (see note below). Slightly magnetic.	C	C	B	A	A	40-45	42-47	Steam valves, dies (hot), punches, pump sleeves, soaking pit tong bits. Vegetable oil mill expeller screws.
Acetylene 40 Arc 140	No color, 3/16, 1/4	Highly resistant to deformation, wear at high temp. High resistance to corrosion from HC, H_2SO_4, HNO_3, PbO_3, etc., in all concentrations. Low coefficient of friction. Machinable (see note below). Slightly magnetic.	C	C	B	A	A	38-42	—	Valves & valve seats for internal combustion engines. Steam valves, draw rings, tong bits.
Acetylene X Arc 100 X	No color, 3/16, 1/4	Forgeable, tough. Machinable (see note below). Holds cutting edge at high temp. Magnetic.	C	C	A	B	D	45-53	—	Specially developed for hot shears. Hot punches and trimming dies, peel heads of open-hearth charging machines. Scarifier teeth, churn drills, etc. where reforging is desirable.

Machining: Coast Metals alloys Nos. 1, 8, 18, 40, and X are machinable with carbide tools of the type used for machining hard cast iron, etc.

A—Excellent
B—Very Good
C—Above Average
D—Average

KEY:

1—NON-MAGNETIC means the matrix of the weld is austenitic. That is, it has a structure similar to the stainless steels of the 18 Cr 8 Ni type. The coefficient of expansion is approximately 50% greater than that of ordinary steels.

2—SLIGHTLY MAGNETIC means that the matrix of the weld has been modified and is no longer austenitic. The coefficient of expansion is approximately the same as, or a little greater than, that of ordinary steels.

3—MAGNETIC means the matrix is ferritic and has been converted from the austenitic by additions of certain elements resulting in higher indentation hardness. (Rockwell C). The coefficient of expansion is equal to that of steel.

NOTE: The Slightly Magnetic and Magnetic groups can be acetylene welded with a minimum of preheating to cylindrical and large sections without the appearance of cracks in the deposit.

Sponsored and prepared for publication in Materials & Methods by

COAST METALS, INC. 1232 CAMDEN AVE., S.W., CANTON 6, OHIO

Wire THAT'S AS BRIGHT AS THE LIGHTS!

. . . a new development possible only because of Geon resin

IT'S true that Christmas comes only once a year, but you can spark a good idea at any time when something gives your imagination a lift!

For a start, look at the Geon polyvinyl insulated wire on this set of Christmas tree lights. Here's wire that in its translucent brightness rivals the decorative values of the lights themselves. No need to hide the wire, for it does as much as the ornaments to brighten up the whole appearance of the tree.

This insulation has novel qualities, because it is based on Geon resin. It's smooth and pliable, won't kink or knot. It comes in an array of gay Christmas colors and the colors *stay* bright. It will last through many seasons and fire hazard is minimized because Geon insulated wire is flame-resistant.

What Geon resin does for this new-type wire is but one example of how it makes better and more saleable products in almost every field. The family of Geon resins makes handsome, durable flooring, stain-and-scuff-resistant upholstery, raincoats, wonderful new draperies and a long list of other products. And you can be sure that with Geon's amazing qualities and versatility there are more new products on the way!

If Geon's possibilities spark your imagination for improving or developing a product, we'll gladly help you. We supply the raw materials only, but our technicians are at your service in working out ideas. Just write Dept. R-10, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

"Plascene" decorative wire by Chester Cable Corp., Chester, N. Y.
"Superior" Christmas tree lighting set by Abbott Manufacturing Co., Summit, N. J.

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American Cladmetals Co.

Materials Engineering File Facts

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NUMBER A-4
October, 1949

ROSSLYN METAL

MATERIALS: Stainless Clad Copper and Other Cladmetals

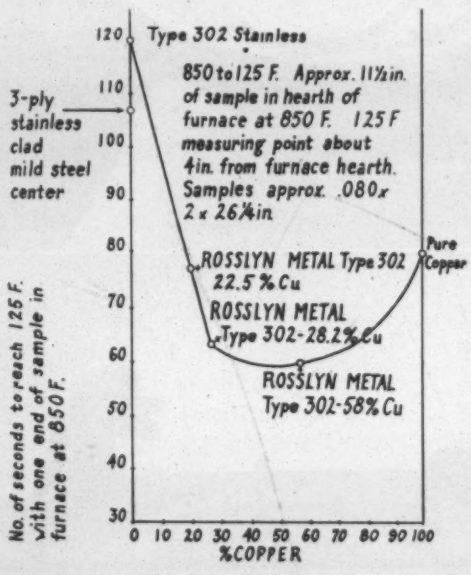
Consisting of copper sheet with stainless steel cladding on both sides, Rosslyn Metal spreads heat or chill fast like copper and resists corrosion like 18:8 types of stainless steel or nickel base alloys. High strength and good ductility, in addition to favorable heat transmission and corrosion properties, make Rosslyn Metal well-adapted to processing equipment such as welded tubes, deep drawn shell forms or spun kettles. The metal is now being used for domestic, institutional and hotel cook-ware, and such commercial installations as steam jacketed kettles, heat exchangers, cooling equipment, pasteurizers and similar units.

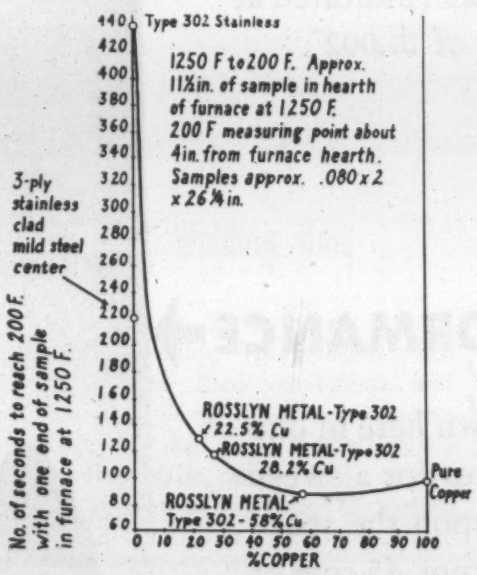
Rosslyn Metal sheets are made in the following standard AISI types of chromium-nickel grades of stainless steel: Types 302, 304, 305, 310, 321, 347, etc., and nickel, Inconel and Monel, in thicknesses from ¼ in. to .025 gage; lengths from 6 in. to 13 ft.; and widths up to 48 in. Other sizes are available for special applications.

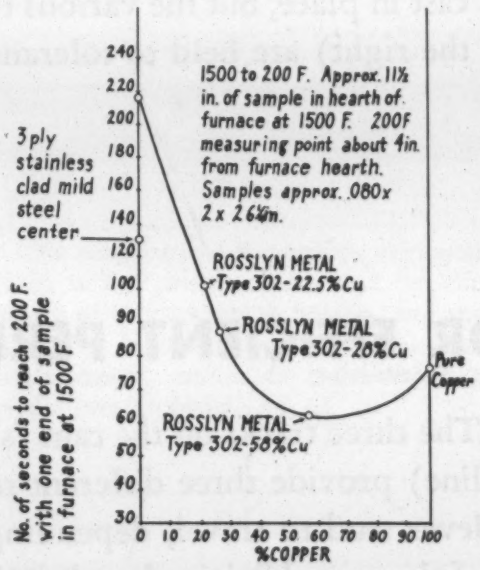
MECHANICAL PROPERTIES OF SEVERAL TYPES OF ROSSLYN METAL

Property \ Rosslyn Metal No.	Inconel	302	310	347
Tensile Strength, Psi.	81,900	85,100	86,300	84,500
Yield Strength, Psi.	48,100	49,100	37,700	46,200
Elongation in 2 in., %	31.0	56.0	60.5	51.0
Cold Bend, Deg.	180	180	180	180

LATERAL CONDUCTIVITY TESTS OF ROSSLYN METAL


Type 302 Stainless
850 to 125 F. Approx. 11½ in. of sample in hearth of furnace at 850 F. 125 F measuring point about 4 in. from furnace hearth. Samples approx. .080 x 2 x 26¼ in.
3-ply stainless clad mild steel center
ROSSLYN METAL Type 302 22.5 % Cu
ROSSLYN METAL Type 302-28.2% Cu
ROSSLYN METAL Type 302-58% Cu
Pure Copper
No. of seconds to reach 125 F. with one end of sample in furnace at 850 F.
%COPPER


Type 302 Stainless
1250 F to 200 F. Approx. 11½ in. of sample in hearth of furnace at 1250 F. 200 F measuring point about 4 in. from furnace hearth. Samples approx. .080 x 2 x 26¼ in.
3-ply stainless clad mild steel center
ROSSLYN METAL-Type 302 22.5% Cu
ROSSLYN METAL-Type 302 28.2% Cu
ROSSLYN METAL Type 302-58% Cu
Pure Copper
No. of seconds to reach 200 F. with one end of sample in furnace at 1250 F.
%COPPER


1500 to 200 F. Approx. 11½ in. of sample in hearth of furnace at 1500 F. 200 F measuring point about 4 in. from furnace hearth. Samples approx. .080 x 2 x 26¼ in.
3 ply stainless clad mild steel center
ROSSLYN METAL Type 302-22.5% Cu
ROSSLYN METAL Type 302-28% Cu
ROSSLYN METAL Type 302-58% Cu
Pure Copper
No. of seconds to reach 200 F. with one end of sample in furnace at 1500 F.
%COPPER

ROSSLYN METAL FABRICATION

OPERATION	TYPE METAL RECOMMENDED	COMMENTS
Welding	All. 321 & 347 when weld cannot be annealed.	Can be welded by metallic arc, inert gas shielded arc, flux hidden arc, carbon arc, and resistance spot or seam welding. Copper drag resulting from shearing or grinding should be removed before welding. Where one side only need be ground flush in finishing, material should be sheared so that feathered edge is finished. Thus greater strength will be developed by heavier bead on struck side. Accurate preparation and fit-up of joints necessary. In metallic arc butt welding, only stainless components are joined, but this joint retains most of strength of sheet. Proper welding procedures bring copper edges into intimate pressure contact assuring conductivity through joint. Where a 100% butt weld is required the abbutting edges should be beveled and a generous gap allowed to produce the 100% weld from one side with a minimum of current. Inconel or 80 Nickel-20 Chrome rod should be used with current characteristics recommended for these rods. When inert gas welding procedure is followed, filler metal should be added of the same analysis as above.
Blanking	All.	Need neat close clearance between punch and die to prevent drag over blank edges. Material must be cut all way through. Too great a die clearance will cause drag on both blank and die edge. Drag may be detrimental to die surfaces because of work hardening.
Drawing	Most of 300 series. For deep drawing: 302, 304.	Same press speeds and die clearances may be used as are used on stainless steels of the chromium-nickel types. With slow press speed, however, uniformity of deformation may be spread over large area to produce unusually deep draws in one press stroke.
Spinning	305. Other types have been used successfully.	Copper core makes spinning somewhat easier than for corresponding stainless steel. Generally spun at ½ the speed used on copper. No. 305 has been spun at 2/3 the speed used for copper.

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ACCURACY!

ZINC DIE CASTINGS GET THE CALL WHEN CLOSE TOLERANCES ARE REQUIRED

TOLERANCES OF ±.002"

This one-piece master cam for General Instrument's new automatic record changer is a typical example of the dimensional accuracy which can be obtained with ZINC die castings. Not only is this one-piece design extremely complex in shape, with gear teeth and projections accurately cast in place, but the various tracks (indicated at the right) are held to tolerances of ±.002".

FOR EFFICIENT PERFORMANCE

The three tracks on the cam (shown here in outline) provide three different routes for a sweep lever stud to travel, depending upon the speed of the record being played—33⅓ rpm, 45 rpm or 78 rpm. The sweep lever is an integral part of the tone arm and any movement of the stud in its track is reflected in a corresponding motion of the tone arm head and needle. Hence the need for close tolerances on the track walls.

A combination of many advantages—of which dimensional accuracy is only one—make ZINC die castings the most widely used. Every die casting company is equipped to make ZINC die castings and will be glad to discuss these advantages with you. Or write to us

The New Jersey Zinc Company, 160 Front Street, New York 7, New York.

ZINC
FOR DIE CASTING ALLOYS

The Research was done, the Alloys were developed, and most Die Castings are based on

HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC

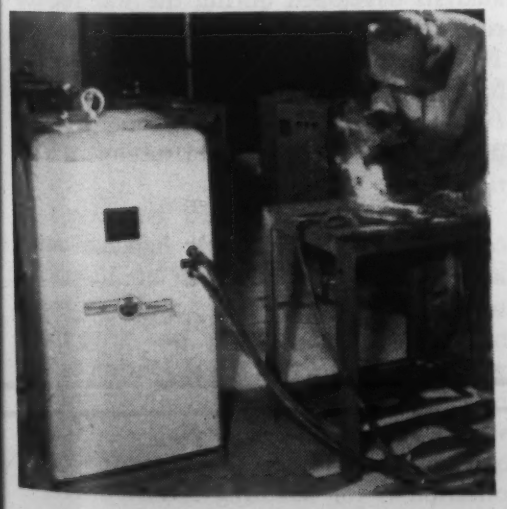
New Materials and Equipment

Plate-Type Rectifier Increases Efficiency of D.C. Welding Unit

A d.c. welding machine, intended to combine the characteristics of d.c. welding with the advantages of a.c. welding machines, through use of plate-type rectifiers, has been developed by *Westinghouse Electric Corp.*, East Pittsburgh, Pa.

The new welder uses high voltage selenium rectifiers, making possible a unit smaller, lighter and more efficient than other plate-type rectifiers of comparable ratings. Essentially a three-phase transformer welder, it also utilizes a three-phase adjustable-core-type reactor for current adjustment.

Efficiency of the welder at rated load is 66% as compared to 54% for an average motor-generator welder. This efficiency increases at reduced load conditions and reaches 73% at 20% of rated load, whereas the efficiency of the conventional motor generator welder falls off to 45% at this load condition. The power factor at normal operating load conditions is comparable to induction-motor-driven welders.



The new Westinghouse d.c. welder saves floor space and weighs less.

The new welder also has a greatly reduced no-load power consumption, amounting to power cost savings of 80 to 86% relative to the conventional welder.

The machine is said to respond rapidly to the changes in current and voltage conditions produced by the welding arc. Time of recovery from rated load to short circuit or vice versa is about 0.007 sec., considerably less than for the average motor-generator welder. Welding with electrodes at low current densities offers particularly good operation.

The 300-amp. welder is about 2 ft. square, 3½ ft. high, and weighs only 510 lb. Thus, it occupies less floor space and weighs about 40% as much as a motor generator welder of comparable rating. A low center of gravity, caused by the location of the transformer and reactor at the bottom of the unit, makes the machine as easily transportable as the conventional horizontal-type motor-generator welder. Lack of rotating parts (except the ventilator fan) makes the machine practically noiseless.

The simplicity of the welder, attributable to its lack of moving parts and the elimination of brushes, brush holders, and shunt and series fields with their attendant control requirements, minimizes maintenance and repair part problems.

New Rubber Adhesive Suitable for Pre-Cementing Applications

A synthetic rubber cement, H-511 Ubabond, making possible the pre-cementing of many materials, has been developed by *Union Bay State Chemical Co.*, 50 Harvard St., Cambridge, Mass.

The new adhesive is claimed to be suitable for bonding steel, aluminum, wood, phenolic resins, synthetic rubber, glass and many other materials.

Upon application, the adhesive dries to a non-tacky condition after a period of 15 to 30 min. at room temperature. As a result, the pre-cemented materials can be handled on an assembly line or shipped for later assembly. When the pre-cemented surfaces are to be joined together, reactivation can be accomplished quickly and easily by heating the surfaces under infra-red, steam or dry heat, or by brushing or spraying a solvent on the pre-cemented surfaces.

New Materials and Equipment
(CONTINUED)

Nickel Layer Makes Possible Gold Plate Rolling Process

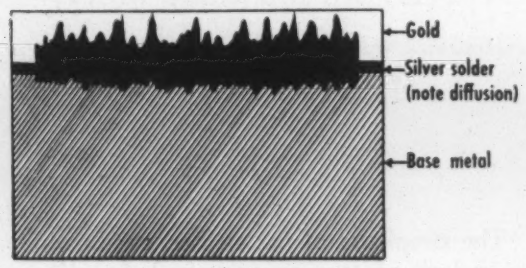
A process by which karat gold can be rolled to a mirror finish and as thin as electroplate on any nonferrous metal base has been developed by the *Gold Filled Div.* of the *American Silver Co., Inc.,* 36-07 Prince St., Flushing, N. Y.

In this Inter-Weld Process, a layer of karat gold is welded to a barrier layer of pure nickel and this dual thickness is then soldered to the base metal. Using the Old Sheffield Process, in which the gold layer is silver-soldered to the base metal, it was impossible to roll the gold down to thicknesses approaching gold electroplate because of the tendency of the silver solder to diffuse or "bleed" through to the surface and present a streaked appearance. Direct welding to nickel eliminates this "bleeding."

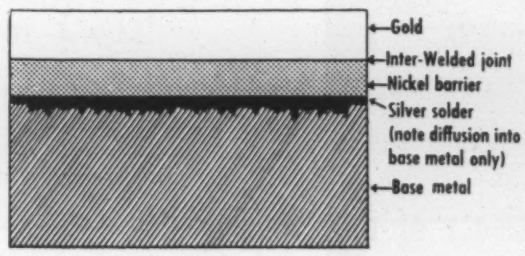
Use of the Inter-Weld Process, instead of the conventional method of manufacturing from brass and then polishing and electroplating to achieve the desirable gold color, is expected to result in production time savings and improved quality. The rolled gold layer is far tougher and longer wearing than a comparable thickness of gold electroplate, and it can be produced in any thickness desired. Improved control of color and surface texture are also claimed for this process.

The American Silver Co. furnishes Inter-Welded rolled gold plate in rolls, the coils interleaved with tissue or, if preferred, protected by a plastic strip coating which can be left on during the stamping and drawing operations. Gold-filled and rolled gold plate can be supplied with a base of brass, nickel silver, nickel, Monel, cupro-nickel, or beryllium copper.

Adaptable also to the manufacture of silver-plated items, the Inter-Weld Process is expected to have widespread effects in the jewelry, cosmetic, novelty and allied industries.



OLD METHOD



INTER-WELD METHOD

The old Sheffield and new American Silver Co. processes of mechanical gold plating are contrasted in these diagrams.

Shear Uses Compound Leverage to Cut Heavy Sheet, Rods

A new metal cutting shear for cutting steel sheets, rod and bar stock up to ⅛-in. thick and even thicker sections of nonferrous metals has been announced by *Super Manufacturing Corp.,* Chicago 24, Ill.

A combination of compound lever, rack and gear are employed in the Super-Shear to multiply the force exerted on the operating handles to the extent required by heavy-duty sheet metal cutting.

Precision Pocket Microscope Developed for Industrial Use

A precision pocket microscope suitable for examining macro-etched samples, surface finishes, castings defects, and similar objects has been announced by the *Bubl Optical Co.,* 1009 Beech Ave., Pittsburgh 12.

The instrument is designed for 40 magnifications when the draw tube is closed and can also be set for 50 and 60 power. With the draw tube closed, the microscope is 5 in. long and has a diameter of ¾ in.

Improved Lead-Bearing Screw Stock Has Better Machinability

An improved lead-bearing, cold-finished steel bar, known as La-Led Free-Machining Screw Stock, has been developed by *LaSalle Steel Co.,* Chicago 80, Ill.

Satin finish and from 44 to 106% better machinability than regular B-1113 stock are claimed for the new product. Because it is an open-hearth steel, it has good ductility, permitting bending and crimping operations. It will also carburize better and have a sounder cross section than Bessemer steel, of which most recently announced free-machining stock is made.

Phosphorus and sulfur, in addition to lead, aid the machinability of La-Led, making it possibly the fastest machining steel ever produced. La-Led is available in 5/16- through 3-in. rounds and in the popular hexagon sizes.

Corrosion Resistant Durimet 20 Now Available in Sheet, Plate

Sheet and plate of Durimet 20, an analysis developed during the war for corrosive applications too severe for standard 18:8 stainless steels, is available for the first time. Developed by the *Duriron Co., Inc.,* Dayton 1, Ohio, Durimet 20 is now produced as bar, strip and tubing in addition to the new forms.

The Durimet alloy has been used for corrosive services formerly handled uneconomically by nonmetallics of insufficient strength or heat transfer, or by extremely high-priced metals, or by low price metals with short life. Although Durimet 20 is higher in price than stainless steel, its service life in some cases may be 100 times or more as great. Its most widespread application is for handling sulfuric acid.

Sheet in gages 11 to 24 and plate, 24-gage to ¾-in., are being produced for stock.

The trend is to N·A·X HIGH-TENSILE STEEL

Since 1940, when Great Lakes Steel pioneered the application of high-tensile, low-alloy steel to cold-stamped automobile bumpers, there has been a growing trend to N-A-X HIGH-TENSILE steel in the automobile industry.

Today, every car manufacturer is using the inherent better properties of N-A-X HIGH-TENSILE steel for some part of his automobile.

Bumpers and grilles—hoods and fenders—body panels and deck lids—frames and bracings—wheels and hub caps represent a few of many applications of N-A-X HIGH-TENSILE steel to the modern car.

MAKE A TON OF SHEET STEEL GO FARTHER
Specify— N·A·X HIGH-TENSILE STEEL

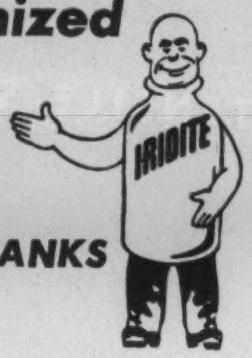
N-A-X HIGH-TENSILE MEETS ALL REQUIREMENTS OF S.A.E. 950

GREAT LAKES STEEL CORPORATION N-A-X ALLOY DIVISION • DETROIT 18, MICHIGAN
Unit of National Steel Corporation

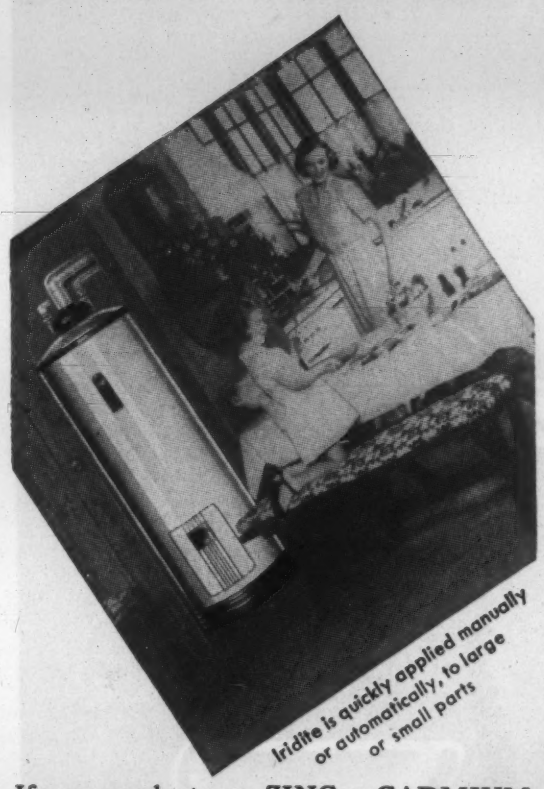
IRIDITE

on Galvanized

Rheem
(Series 41)
HOT WATER TANKS
gives



LONGER LIFE
BETTER SERVICE



If your products use ZINC or CADMIUM in any form, you'll want to know about Iridite, the non-electric chemical coating that offers you 3-way protection—

- √ guards against corrosion on zinc or cadmium—lengthens product life
- √ gives better paint adherence on zinc or cadmium—improves entire finishing system
- √ brightens zinc or cadmium—keeps it bright and eye-shining to help boost sales. Also available in colors.

Whatever your needs in finishing zinc or cadmium, there's an Iridite to do the job. Write today for FREE FOLDER and full information—or better still—send samples of your product for free treatment.

ALLIED RESEARCH PRODUCTS, INC.
4004 EAST MONUMENT STREET
BALTIMORE 5, MD.

West Coast Licensee—
L. H. Butcher Co., Los Angeles 23, California

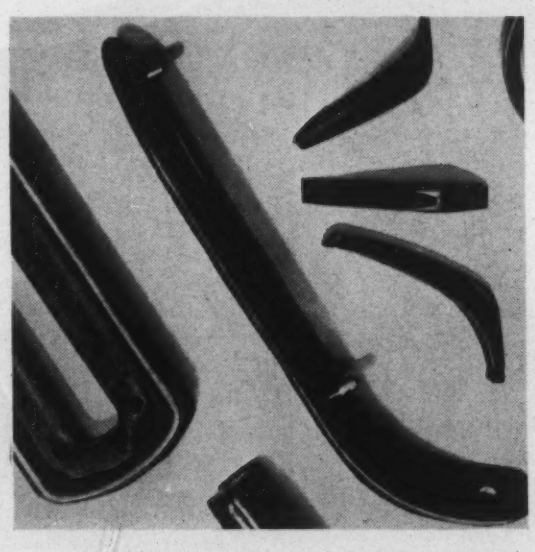
New Materials and Equipment

Plasticized-Rubber Compound Combines Hardness, Resilience

A new plasticized-rubber compound, Stallite 869, combining the outstanding characteristics of rubber and plastics, has been announced by *Stalwart Rubber Co.*, 165 Northfield Rd., Bedford, Ohio.

The versatile material is recommended for use in the fabrication of tool handles, foot treadles, mallet heads, toys, vacuum cleaner accessories, and other applications requiring an extremely durable, wear-resistant rubber. It can also be used to replace certain types of metal parts.

Stallite 869 has a durometer hardness of 95 and a tensile strength of 1854 psi. It will withstand temperatures ranging from 0 to 250 F. Resilient and flexible despite its high durometer hardness, Stallite 869 possesses high impact strength, corrosion resistance and light weight. Secondary drilling and machining operations can be performed on parts fabricated from this new compound.



This new product of the Stalwart Rubber Co. is suitable for tool handles, toys, etc.

All types of molded parts will be fabricated from this material on order. Present stocks are black in color, but parts can be painted for decorative applications.

● A high-strength adhesive developed by the *B. F. Goodrich Co.* and *General Motors Research Laboratory* is said to have twice the safety of rivets. The new material has been used for bonding linings to truck and passenger car brake shoes, entirely eliminating rivets, and substantially increasing brake life and efficiency.

Free Folder!

--tells how to finish ZINC OR CADMIUM for better CORROSION RESISTANCE ...PAINT BASE

Eye Appeal

If your product uses zinc or cadmium in any form, find out now about Iridite . . . the chemical dip finishes that boost corrosion resistance . . . provide a paint base that defies peeling, flaking, chipping . . . brighten zinc, keeps it bright and free from stains. Write for details today . . . or better still, send samples of your product for FREE processing.

IRIDITE COATINGS
are used on--

Washing Machine Parts • Radio Equipment
Kitchen Utensils • Aircraft Parts
Lock Hardware • Office Machines
Window Frames • Vending Machines
Wire Cloth • Tools
Lamp Fixtures • Fuel Pumps
Carburetors • Auto Hardware
Zinc Coated Sheet • Hinges, Screws, Bolts
Camera Parts • Plumbing Fixtures
Wall Panels • Refrigerator Parts
Wire Products • Instrument Parts
Electrical Equipment

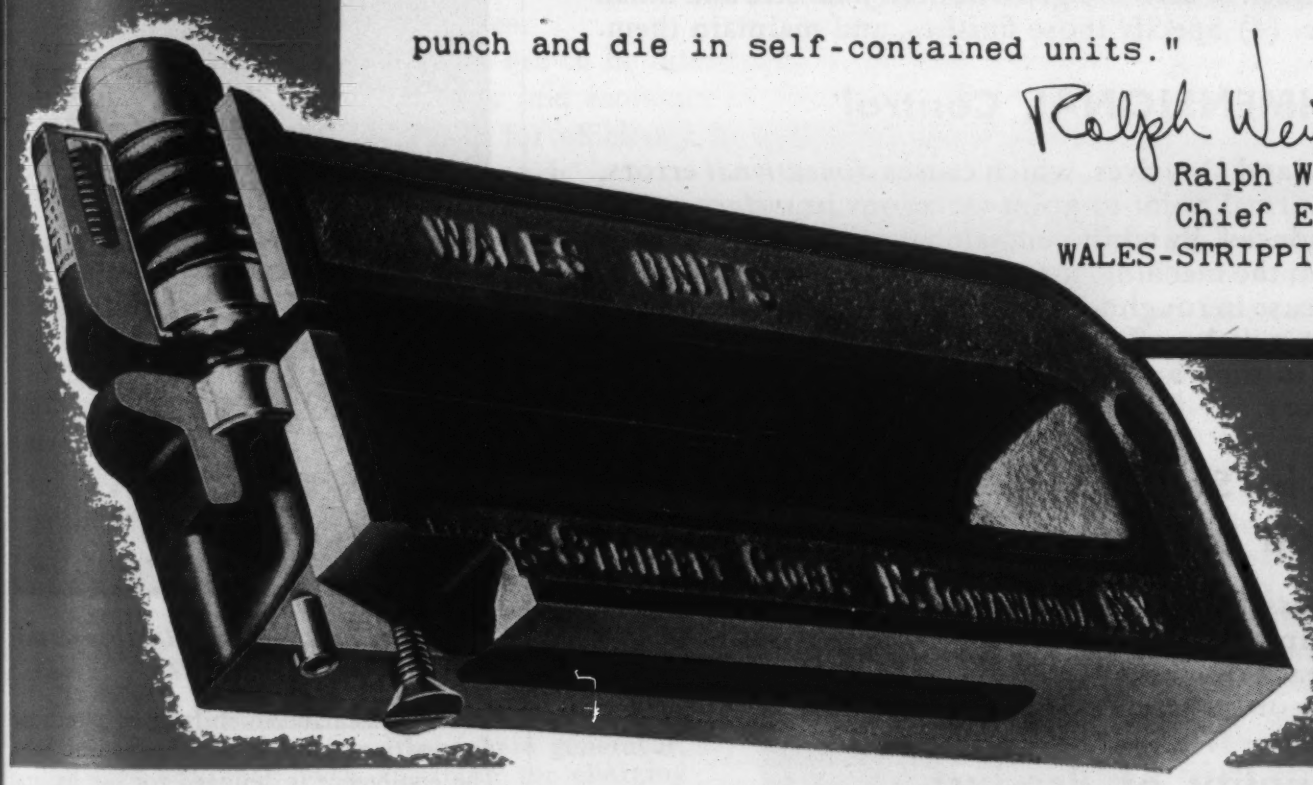
ALLIED RESEARCH PRODUCTS, INC.
4004 EAST MONUMENT STREET
BALTIMORE 5, MD.

A Chief Engineer speaks... about MEEHANITE® Castings

"Meehanite castings provide the combination of qualities that definitely contributes to the successful manufacture and function of our sheetmetal perforating units. Their ability to take a smooth finish and their wear resisting properties greatly increases the life of the units. The freedom from warpage or movement after machining found in Meehanite castings is of utmost importance in maintaining alignment of punch and die in self-contained units."

Ralph Weisbeck

Ralph Weisbeck
Chief Engineer
WALES-STRIPPIT CORPORATION



Cut-away view of a Wales type "BL" Hole Punching Unit. Many size punch holders of this type are made of Meehanite castings for the Wales-Strippit Corporation, North Tonawanda, N. Y.

The above statements express the importance of dependability and quality to those who carefully select and specify required engineering characteristics for their components. In the manufacture of Meehanite castings control of metal structure permits achievement of desired properties. When you insist upon Meehanite castings you are insuring just such benefits and economies plus built-in quality of your equipment.

For details covering a wide range of general industrial applications write for our four volume series "Meehanite Means Better Castings."

MEEHANITE FOUNDRIES

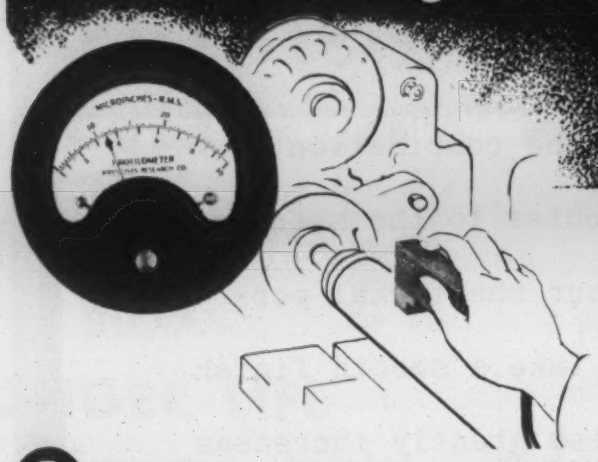
American Brake Shoe Co.	Mahwah, New Jersey
The American Laundry Machinery Co.	Rochester, New York
Atlas Foundry Co.	Detroit, Michigan
Banner Iron Works	St. Louis, Missouri
Barnett Foundry & Machine Co.	Irvington, New Jersey
H. W. Butterworth & Sons Co.	Bethayres, Pennsylvania
Continental Gin Co.	Birmingham, Alabama
The Cooper-Bessemer Corp.	Mt. Vernon, Ohio and Grove City, Pa.
Crawford & Doherty Foundry Co.	Portland, Oregon
Farrel-Birmingham Co., Inc.	Ansonia, Connecticut
Florence Pipe Foundry & Machine Co.	Florence, New Jersey
Fulton Foundry & Machine Co., Inc.	Cleveland, Ohio
General Foundry & Manufacturing Co.	Flint, Michigan
Greenlee Foundry Co.	Chicago, Illinois
The Hamilton Foundry & Machine Co.	Hamilton, Ohio
Johnstone Foundries, Inc.	Grove City, Pennsylvania
Kanawha Manufacturing Co.	Charleston, West Virginia
Koehring Co.	Milwaukee, Wisconsin
Lincoln Foundry Corp.	Los Angeles, California
E. Long Ltd.	Orillia, Ontario
Otis-Fensom Elevator Co., Ltd.	Hamilton, Ontario
The Henry Perkins Co.	Bridgewater, Massachusetts
Pohlman Foundry Co., Inc.	Buffalo, New York
Rosedale Foundry & Machine Co.	Pittsburgh, Pennsylvania
Ross-Meehan Foundries	Chattanooga, Tennessee
Shenango-Penn Mold Co.	Dover, Ohio
Sonith Industries, Inc.	Indianapolis, Ind.
Standard Foundry Co.	Worcester, Massachusetts
The Stearns-Roger Manufacturing Co.	Denver, Colorado
Traylor Engineering & Mfg. Co.	Allentown, Pennsylvania
U. S. Challenge Co.	Centerville, Iowa
Valley Iron Works, Inc.	St. Paul, Minnesota
Vulcan Foundry Co.	Oakland, California
Warren Foundry & Pipe Corporation	Phillipsburg, New Jersey

"This advertisement sponsored by foundries listed above."

Meehanite® NEW ROCHELLE, N. Y.

4 BIG ADVANTAGES

Available Through SHOP CONTROL OF SURFACE ROUGHNESS!



Through control of surface roughness, your production departments can—

1 Reduce Sizing and Finishing Time

The procedure is simple: (1) Check the finish obtained from each step of the present series of operations. (2) Eliminate any operations that contribute little or nothing to final size and finish. (You may find *several* such operations.) (3) Check the remaining operations to determine what finish *at each step* gives desired *final* size and finish in lowest total time. (4) Specify those finishes, and maintain them.

2 Save on DIMENSIONAL Control

The dulling of tools and abrasives, which causes *dimensional* errors, first increases the normal point-to-point variations in *surface roughness* of the parts produced. By taking occasional roughness measurements on the parts at the machine, the inspector or operator detects the *start* of this increase in roughness variation, and knows that soon thereafter the work will be off-size. Thus tools can be sharpened or wheels dressed in time to prevent dimensional errors—yet no oftener than necessary.

3 Save Time in Setting Up for Duplication of Long and Short Runs

By making roughness measurements during set-up, the operator can quickly determine the effects of steps taken to obtain the required finish from each operation. Thus he can complete the set-up faster and with little or no scrap.

4 Improve Quality of Product

This is done by making sure that important surfaces are consistently finished to the roughness values required for best performance of the product.

These advantages, and others too, are being obtained in hundreds of plants by NUMERICALLY SPECIFYING the microinch roughness of machined, ground and finished surfaces—external and internal—and by CHECKING those surfaces with the Profilometer . . . quickly, accurately, in the shop.

Think it over—write for informative literature—and arrange for a Profilometer demonstration in your plant.

Profilometer is a registered trade name

A SURFACE CONTROL INSTRUMENT BY

PHYSICISTS RESEARCH COMPANY

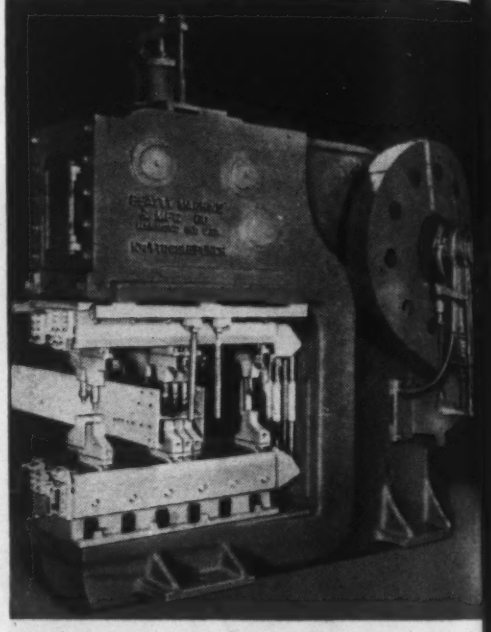
ANN ARBOR • MICHIGAN

New Materials and Equipment

Adjustable Set of Punch Tools Designed for Structural Steel

A new adjustable set of punch tools f punching webs of beams and channels an punching legs of angles and plates has bee announced by *Beatty Machine & Mfg. Co.* Hammond, Ind.

The tools provide for quick initial set-u



The Beatty punch will handle channel web and angle legs.

and for instantaneous shifting of punch an die positions to pick up off-gage-line hole The equipment is designed for use by larg structural steel fabricators and fits an Beatty Toggle Beam Punch.

Aluminum Re-Draw Rod Coils Now Available to Wire Manufacturers

Aluminum re-draw rod coils of ⅜-in dia. are now available in two alloys, EC and 61S, from the *Reynolds Metal Co.* rod mill at Listerhill, Ala.

Used primarily by large producers o wire who draw the rod into smaller wire sizes, the coils have 48-in. O.D., 36-in I.D., and weigh 150 lb. each. Rod diameter tolerances are ±1.64 in.

The material is being supplied in the following alloys and tempers: EC-H16 EC-H12, EC-0, 61S-F and 61S-0. The EC H16 rod is generally used for finished wire sizes of 0.135-in. dia. and larger; for wire sizes of 0.077- to 0.135-in. dia., EC-H12 is recommended.

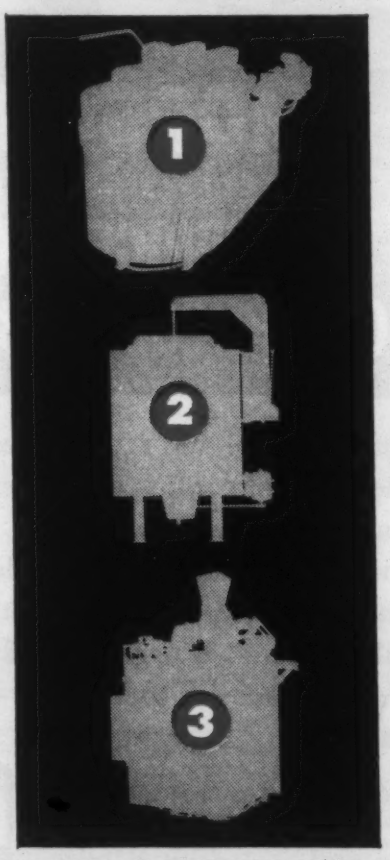
3 New INDUSTRIAL FURNACES

Engineered by 'Surface' for

GREATER ECONOMY OF PRODUCTION

Surface Combustion Heating and Heat Treating Furnaces always have been engineered for the utmost economy of production. This means the most efficient furnace design and operating characteristics for the specific job . . . whether the requirements were for standard rated units or special continuous production types.

Now, three new furnace units are to be introduced to provide the heat treater with even greater flexibility and economy in operation. These units meet current needs and demands for efficiency in operation, labor saving, with minimum space and maintenance.



1 'Surface' Forc-Aire Furnace . . employs convection heating at its greatest efficiency. A new standard design embodying proved combustion principles with modern features to meet today's requirements for highly efficient furnace operation. *Unit on display at 'Surface' booth.*

2 'Surface' Atmotrol Furnace . . a new standard design unit of the vertical muffle type for batch heat treating. Can be used with any prepared gas atmosphere for all modern heat treating processes. Provides extreme flexibility in operation. *Unit on display at 'Surface' booth.*

3 'Surface' Batch-type, Atmosphere Furnace . . high-capacity, radiant tube heated furnace with built-in prepared gas atmosphere generator. Also equipped with vestibule for charging and slow cooling, and a lowerator mechanism and tank for liquid quenching. Especially adaptable to gas carburizing, carbon restoration (skin recovery), dry cyaniding, homogeneous carburization, clean hardening, and for general heat treating.

and in addition . . .

HOMOGENEOUS CARBURIZATION . . . a process whereby fabricated metal parts of thin section made from low carbon steel, can be heat treated in an atmosphere to transform the metal to a medium or high carbon steel, as desired.

GET ALL THE PARTICULARS AT 'Surface'

Welcome

TO 'SURFACE' HEAT TREAT HEADQUARTERS

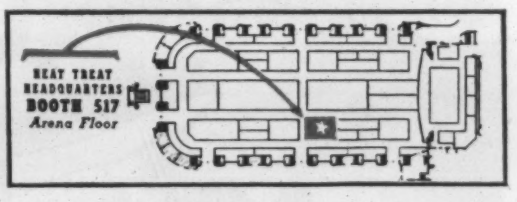
BOOTH 517

Arena Floor

NATIONAL METAL EXPOSITION

● For the 30th year, Surface Combustion will bring new innovations in heat treating processes and equipment to visitors at the National Metal Exposition.

The 'Surface' booth located in the main arena of the Public Auditorium, Cleveland, will be larger in floor space and there will be displayed three new furnace units designed to give *greater economy of production.*



'Surface' Industrial Furnace Engineers will be available at all times to answer questions and explain the many heat treating processes that have been developed in the 'Surface' research laboratory in Toledo, Ohio.

Complete descriptive and specification literature on special furnaces, standard rated furnaces, industrial burners, special gas atmosphere generators and special heat treat processes will be available to all who visit the show. The processes include gas carburizing, suspended carburization, carbon restoration (skin recovery), homogeneous carburization, clean and bright atmosphere hardening, dry (gas) cyaniding, bright super-fast gas quenching, atmosphere malleableizing, atmosphere heating for forging and high speed billet heating.

'Surface' cordially invites you to "heat treat headquarters" at the National Metal Exposition.

BOOTH 517
Arena Floor
Cleveland Public Auditorium
NATIONAL METAL EXPOSITION
October 17 through 21

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

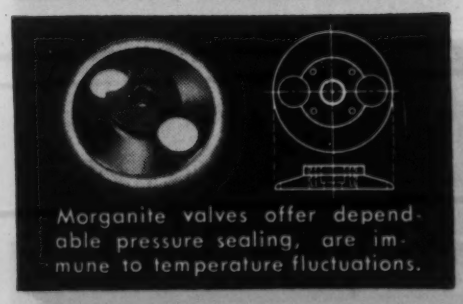
PROBLEM: To find a refrigeration compressor blade featuring self-lubrication... to be non-gumming and corrosion-resistant... and immune to warping.

SOLUTION: Blades of self-lubricating Morganite provided long service... no sticking... no chemical deterioration.

MORGANITE
SELF-LUBRICATING
REFRIGERATION COMPRESSOR BLADES

The substantial savings on maintenance and replacement costs made possible in the operation of cooling compressors is only one example of Morganite effectiveness in increasing efficiency. Morganite valves, seals, rings, slides and other self-lubricating components provide a ready solution to many stubborn mechanical problems. Morganite has frequently offered the one practical answer to industry-old problems of design and operation.

Liquid meter pistons of Morganite resist corrosion, will not gum or stick, are non-contaminating.



Morganite valves offer dependable pressure sealing, are immune to temperature fluctuations.

FOR DETAILED INFORMATION consult the Morganite Catalog in Sweets File for Product Designers; for engineering counsel or specific proposals, call Morganite

see our CATALOG in SWEET'S FILE for PRODUCT DESIGNERS

Morganite INCORPORATED
LONG ISLAND CITY 1, NEW YORK

REGISTERED TRADE MARK

Manufacturers of Morganite Carbon Brushes for all motor and generator applications, and Morganite Carbon Piles

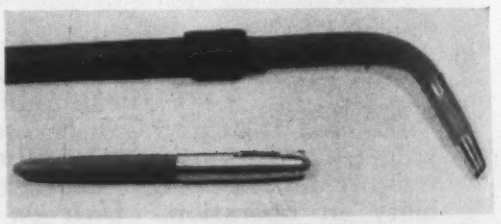
New Materials and Equipment

Miniature Electrode Holder Reaches Inaccessible Places

A miniature inert-arc electrode holder, specifically designed for fluxless welding of thin-gage (16 to 40) nonferrous metals, has been announced by the *Welding Div.* of *General Electric Corp.*, Schenectady 5, N. Y.

The holder features a flexible front-end assembly made of malleable copper tubing surrounded by a sheath of silicone rubber so that it can be bent in any direction to reach hard-to-get-at places. It is available in two models, one for 0.010- and 0.020-in. tungsten electrodes, and the other for 0.040- and 1/16-in. tungsten electrodes. It has a continuous current rating of 40 amp. and operates a.c. or d.c. Currents as high as 60 amp. can be used if low duty cycles are employed to prevent overheating.

The new welding tool is expected to find application in the manufacture and repair



This new General Electric electrode holder is designed for fluxless welding of thin-gage nonferrous metals.

of surgical instruments, cutlery, business machines, control and measurement equipment, wire fittings, metal novelties, small sheet metal enclosures, etc. It can be used with stainless steel, aluminum, brass, copper, nickel, Monel, Inconel, gold, silver, tantalum and other metals.

Alloy Steel Bars Rough Ground Automatically by New Machine

An automatic machine for the rough surface grinding of alloy steel bars has been developed by *Wilbur B. Driver Co.*, 150 Riverside Ave., Newark 4, N. J.

The feeding mechanism consists principally of two planetary units which turn the bar and at the same time advance it under a high-speed grinding wheel. The grinding wheel is kept in constant contact with the bar, but the pressure is varied

the trend is to TRENT

LARGE DIAMETER STAINLESS STEEL TUBING

Here's why:

- Largest variety of sizes — 4″ to 30″ inclusive
- Finished tubing . . . machine-formed, machine-welded machine-sized for uniformity
- Made in a *tube* mill by *tube* experts
- Tested cold rolled sheets . . . completely fused into finished tubing *without* added rod metal
- No zone of weakness for corrosion to attack
- Uniform section, metallurgically correct
- Available for fabrication with any fittings
- All finishes available

All these features add up to better tubing that's easier to apply and maintain, and economical as well. That's why more and more designers, fabricators and manufacturers of all types of processing equipment are looking to Trent for their stainless tubing requirements. They know that Trent Tubing is made in a *tube* mill, and that the complete Trent line . . . $\frac{1}{8}$″ to 30″ inclusive . . . offers the greatest variety of stainless tubing sizes available.

When you do business with Trent, you get top quality tubing PLUS engineering consultant service that helps you put stainless tubing to work in your application . . . *Better!* Write for Trent Data Bulletin and tell us what application you have in mind.

TRENT TUBE COMPANY

Subsidiary of Crucible Steel Company of America

General Office and Plant — East Troy, Wisconsin • Sales Offices:
Chicago: 4501 W. Cortland St. — New York: Chrysler Building

TRENT

STAINLESS STEEL TUBING

PERMACLAD

STAINLESS CLAD STEEL

Truly Corrosion Resistant!
Easily Formed or Deep Drawn!

AND SEE HOW MUCH YOU CAN SAVE

Modernize Your Products
Increase Your Sales

You save money, improve your products and increase sales when you fabricate your products from PERMACLAD. It's an entirely new and different material with the surface characteristics of stainless steel and the excellent formability and other desirable physical characteristics of plain carbon steel. PERMACLAD is truly corrosion resistant and has better ductility than other materials of equal corrosion resistance. For most applications 10% cladding is suitable but the percentage of cladding can be increased to 20% or more if necessary, and regardless of the severity of the draw the percentage of cladding remains constant.

There are cost cutting applications for PERMACLAD in almost every industry. Products from deep freeze units and shower stalls to automotive trim and chemical and food vessels are now made from PERMACLAD. Profit by getting all the facts about PERMACLAD now. Write or send the coupon below for free folder and information.

THE FINER THE FINISH THE FINER THE PRODUCT
FOR THE FINEST FINISH USE
PERMACLAD

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PERMACLAD

STAINLESS CLAD STEEL

A Product of: **ALAN WOOD STEEL COMPANY**
Conshohocken, Pa., Dept. P-35

GENTLEMEN: *Please send me more information and free folder about* PERMACLAD.

*Name*_____ *Title*_____

*Company*_____

*City*_____ *State*_____

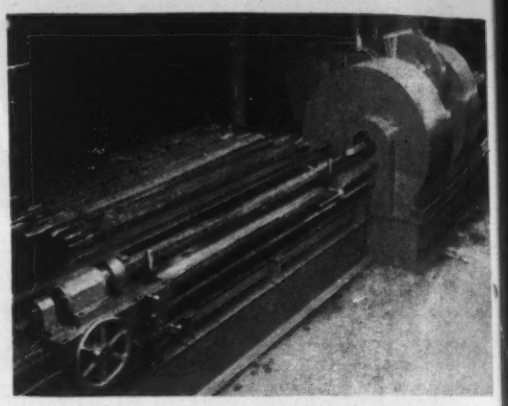
• PERMACLAD • PERMACLAD • PERMACLAD • PERMACLAD •

OTHER PRODUCTS: AW Algrip, Abrasive Floor Plate • AW Super-Diamond Floor Plate • Billets • Plates • Sheets (Alloy and Special Grades).

New Materials and Equipment

during the grinding operation in order to prevent excessive wear at the corners. The amount of pressure can also be adjusted to provide a deep or light cut, as may be desired.

The new machine, known as the Tophet Automatic Bar Grinder, will remove a uniform amount of stock from all sides of the bar and expose the entire surface for in-



The feeding mechanism of this Wilbur B. Driver Co. grinder consists of two planetary units.

spection. If spot grinding is required, it can be accomplished as an extra operation with a conventional swing or hand grinder.

The following advantages are claimed for the new grinder:

1. Reduction of an unpleasant task for which it is difficult to recruit a suitable work force.
2. Substantial labor savings.
3. Improved grinding wheel life.
4. Reduction in metal loss.
5. Segregation of grinding dust to permit recovery of metallics.

Special Austenitic Alloy Steel Performs Well as Low as –423 F

Lebanon Steel Foundry, Lebanon, Pa., has developed a new alloy steel capable of good engineering performance at temperatures as low as –423 F.

Lebanon Grade 22 is an austenitic cast ferrous alloy, its composition including 19.5 chromium and 9% nickel. It has been used effectively in the production of steel castings for pressure storage equipment for liquid oxygen used as a propellant for rocket engines. This storage is under high pressures at temperatures approximating –298 F.

Grade 22 has also demonstrated good heat resistance in applications involving ex-

FLAME-RESISTANT

LIGHTWEIGHT

ECONOMICAL

VERSATILE

COLORFUL

TOUGH

Housing is molded in two nesting parts. Pin-point gating reduces finishing operations, yields sturdy pieces free from flow marks. Motor, circulating fan and scent-block assembly are held in place by a metal bracket mounted by means of four metal bushings press-fitted into the plastic housing.

(DISTRIBUTED BY Y & Y DEODORIZER CO., PHILADELPHIA, PA.)

Another Design *First*

attained with "Hercules" Flame-Resistant Acetate

First device of its type to be molded with "Hercules" Flame-Resistant Acetate, the IRO Electric Deodorizer also becomes the the first commercially available model to obtain Underwriters' Laboratories approval.

"Hercules" Flame-Resistant Acetate gives the housing of this unique deodorizer its impact strength, its attractive ivory color, as well as the all-important advantage of a truly self-extinguishing material which can be rapidly injection molded.

Housings and similar applications utilizing "Hercules" Flame-Resistant Acetate are bringing added sales appeal to a growing list of electrical appliances. Our technical staff invites inquiries on improving *your* product with a quality Hercules material.

CELLULOSE ACETATE

"HERCULES" IS REG. U. S. PAT. OFF.

HERCULES POWDER COMPANY

INCORPORATED

996 Market Street, Wilmington 99, Delaware

CP9-8

See Our Demonstration-- at the A.S.M. Show

Heat-Resistant KENNAMETAL

GRADE K138

Withstands Oxidation – Resists Thermal Shock
Retains High Strength
at 1800° F.

In the demonstration, a tube of this distinctive material, basically Titanium Carbide, simulates a Resistance Heating Element. It is subjected to alternate electric heating and air cooling in one-minute cycles, while under constant tensile stress of 10,000 p.s.i. Temperature range 1800° to 180° F.

Also featured in the display is a Thermocouple Protection Tube made of Kennametal, which, by means of a high frequency induction coil, is maintained at a temperature of 2600° F.

The Grade K138 series includes several different compositions, each having a specific combination of properties that meet some particular operating condition at elevated temperatures.

Visit the Kennametal Booth. Witness a continuing demonstration of this distinctive development. Talk with our representatives. Perhaps here is the material you have been seeking, but never have found before – heat-resistant Kennametal K138.

KENNAMETAL® *Inc.*, Latrobe, Pa.
SUPERIOR CEMENTED CARBIDES

KENNAMETAL DISPLAY
Booth 520
IN THE ARENA

New Materials and Equipment

tremely high operating temperatures, *e.g.* jet-engine components, turbo-supercharger parts, and other gas turbine uses.

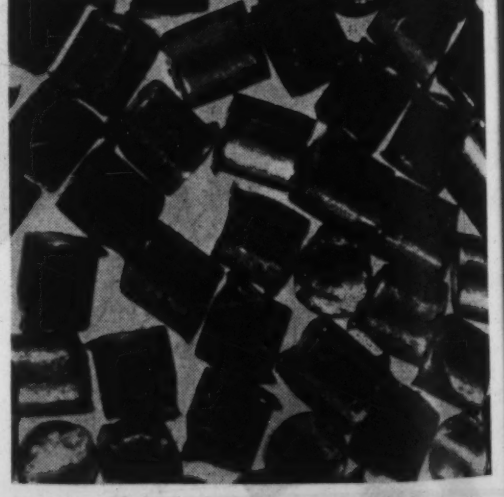
Laboratory tests have shown that both hardness and tensile strength of this alloy vary inversely with temperature. Thus, the tensile strength is estimated to be 200,000 psi. at –423 F. There is a corresponding loss of ductility as temperature is lowered, but it is not in proportion to the increase in tensile strength.

The alloy can be easily welded by either gas or electric processes without need for subsequent heat treatment, since low temperatures do not seriously impair the as-welded impact resistance.

High-Strength Cut Wire Shot Has Long Life in Cleaning, Peening

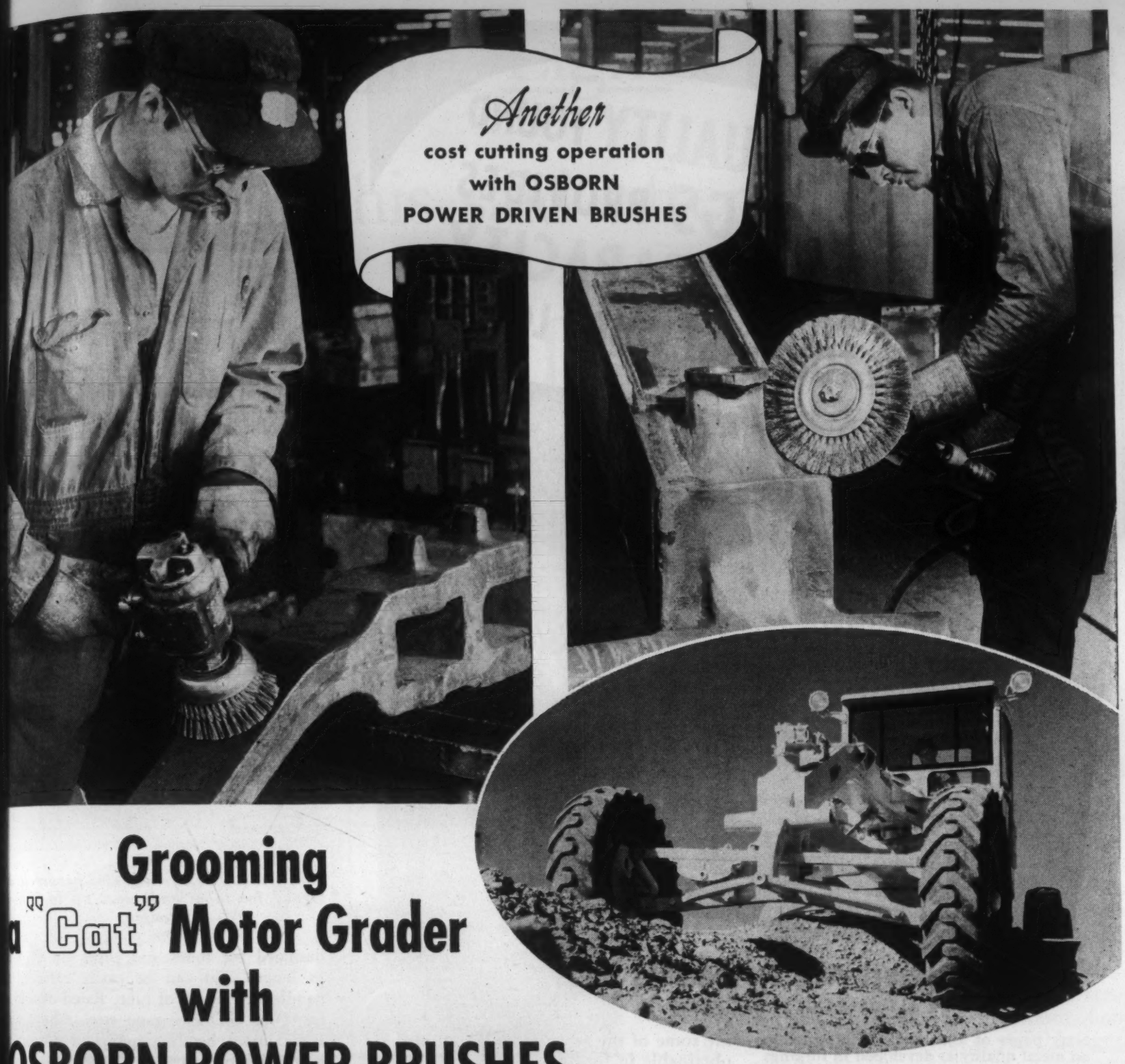
Cutwire shot, manufactured by *Precision Shot Co.*, 6432 Cass Ave., Detroit 2, Mich., from high-quality SAE 1065 wire, is now available for peening and cleaning operations.

Life of Cutwire Shot is said to be 1500 cycles, as opposed to the 2½- to 10-cycle life of conventional chilled iron shot. Uniformity of physical properties, maintenance of size, and lower machine maintenance costs are other advantages claimed for the wire shot. In use, the shot quickly deforms into a full round shape.



A life of 1500 cycles is claimed for Cutwire Shot.

The shot is now available in diameters from 0.014 to 0.072 in.



Grooming a "Cat" Motor Grader with OSBORN POWER BRUSHES

THE Caterpillar Tractor Co., Peoria, Illinois, is world famous for its earth-moving and road-building equipment.

And typical of the company's high standards of manufacture, many exterior metal parts of "Caterpillar" Machines are thoroughly cleaned of extraneous, rust-forming matter with Osborn Power Driven Brushes.

Shown in the photos above are two examples of the effective method employed in the removal of weld and heat scale from circle drawbar assembly and steel frames of "Caterpillar" Motor Graders.

In upper left, an Osborn Disc-Center* Wire Cup Brush, mounted on a portable air tool, cuts away heat scale from a "Caterpillar" drawbar and provides a really clean finish for painting.

In upper right, an Osborn Disc-Center* Wire Wheel Brush quickly removes weld scale from a heavy "Cat" Motor Grader frame and leaves the metal surface in perfect condition for subsequent painting.

This is just one of hundreds of "case histories" where longer lasting Osborn Power Driven Brushes are cutting production costs in finishing operations.

If you have an industrial finishing problem, why not let an informed Osborn sales engineer provide you with cost-cutting facts on Osborn Brushes—without obligation.

*Trademark

See Osborn's complete line of industrial brushes at the National Metal Exposition, Cleveland, Ohio, October 17-21, Booth No. 817.

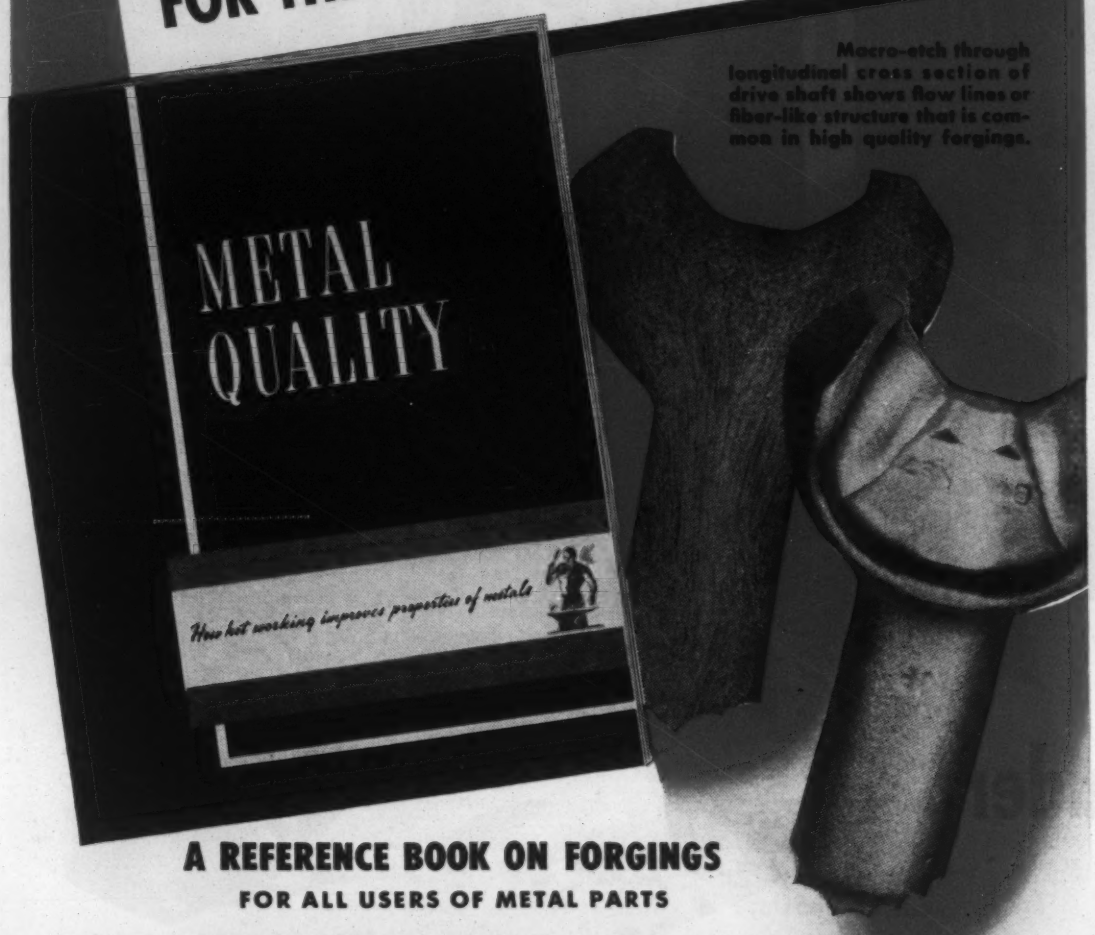
THE OSBORN MANUFACTURING COMPANY

Dept. 196, 5401 Hamilton Avenue *Cleveland, Ohio*

Osborn Brushes®

WORLD'S LARGEST MANUFACTURER OF BRUSHES FOR INDUSTRY • POWER DRIVEN BRUSHES • PAINT BRUSHES • MAINTENANCE BRUSHES

THE METAL QUALITY FOUND IN FORGINGS PROVIDES MATCHLESS CAPACITY FOR THE TOUGHEST WORK LOADS


METAL QUALITY
How hot working improves properties of metals
Macro-etch through longitudinal cross section of drive shaft shows flow lines or fiber-like structure that is common in high quality forgings.

A REFERENCE BOOK ON FORGINGS
FOR ALL USERS OF METAL PARTS

Sixty pages of authoritative information on metal quality as developed in forgings formed through the use of closed impression dies. Forging production techniques are described and illustrated; economic advantages of forgings are presented from the viewpoint of top management, design engineers, metallurgists and production executives. Your copy is ready. Fill in and attach coupon below to your business letterhead.

* * *

A product fortified with the metal quality found in forgings outperforms other products. Forgings' grain structure and fiber-like flow lines are controlled, directioned, and concentrated at points where the highest stress and shock occur under actual service conditions. High tensile and impact strength, the reduction of dead weight, and freedom from concealed defects are some of the advantages which are obtainable in forgings.

Now is an excellent time to check your product for cost reductions—explore every possibility to improve performance and appearance, while reducing dead weight of component parts. Double check all parts subject to the greatest stress and strain. Check machining and finishing time schedules—forgings have been known to speed up production by 250 per cent. Rejects at the point of assembly are costly—a needless waste; forgings offer practically a 100 per cent yield of sound parts—and they respond uniformly to heat treatment. Consult a forging engineer—only a forging engineer can inform you fully regarding the many advantages obtainable with forgings.

DROP FORGING ASSOCIATION
605 HANNA BUILDING
CLEVELAND 15, OHIO

Please send 60-page booklet entitled "Metal Quality—How Hot Working Improves Properties of Metal", 1949 Edition.

Name .....

Position .....

Company .....

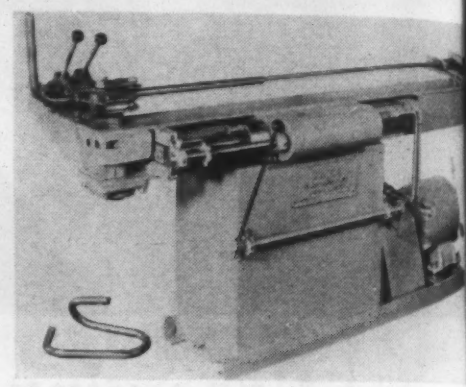
Address .....

New Materials and Equipment

Semi-Automatic Tube Bender Is Suitable for Maintenance Work

A semi-automatic hydraulic tube bendi machine, especially suitable for short r and maintenance work requiring freque changeovers of setups, has been develop by *Pines Engineering Co.*, Aurora, Ill.

Designated as a series 1400 bender, it



This Pines Engineering Co. bender is d signed for tubes and pipes up to 5 ft. length.

designed for tubes and pipes up to 5 in length, but can be easily extended handle any length of tube. Rated capacity for 1-in. O.D., 16-gage steel tubing wi a maximum bending radius of 8½ in. center line of tube.

Carbon-Graphite Material Finds Application in Small Bearing

A carbon-graphite material, composed extremely fine well-bonded particles a intended for use as bearings, has been d veloped by *Pure Carbon Co.*, St. Marys, P

Known as Purebon No. 5, the material said to be non-toxic and highly resista to wear and abrasion. It does not discol material with which it comes in conta and it can be run dry up to certain limi of speed and loading without undue wea ing or galling of the metal shaft. In com mon with similar graphite products, it do not melt, seize or change shape when su jected to high temperatures, and it is un affected by most strong acids, alkalis o other corrosive liquids.

The new product is claimed to be th lowest cost bearing material available fo very small bearings where it can be molde to size. On larger sizes it can be molde

Only Magnesium-Light is light enough"

You'll hear this said often about Dow

MAGNESIUM

the world's lightest structural metal!

With the value of lightness emphasized by constantly rising costs, operators in the motor transport field want more than just lightweight equipment—they want equipment that is *magnesium-light*. These men who use everything from small panel trucks to huge trailers know that only with magnesium can maximum lightness be achieved.

Magnesium is strong and durable and yet is a full one-third lighter than any other structural metal. This bonus—this premium of one-third greater lightness—makes possible significant weight savings which are immediately reflected in increased payload and decreased operating and maintenance costs. A properly designed magnesium body is frequently 20-25% lighter than the same size body built with other light metals.

This is just one of the fields where magnesium increases efficiency by cutting dead weight to a minimum. It will pay you to investigate magnesium lightness when designing your product. For case studies on successful uses of magnesium, send for "How Magnesium Pays."

Get maximum weight reduction— Use Magnesium Extrusions

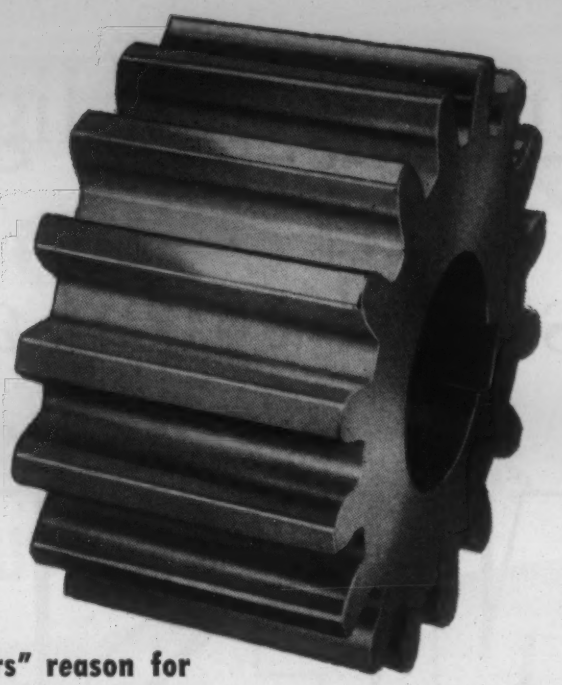
Magnesium extrusions can give you significant weight reductions without the loss of needed strength and rigidity. Often, the use of magnesium extrusions tailored to your particular needs will cut manufacturing costs by eliminating the necessity of forming or fabricating from standard shapes. They are competitively priced and available in rods, bars, and tubes as well as structural shapes conforming closely to American Standard Sections.

Lighter Products Sell—make your product Magnesium Light!

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago • St. Louis • Houston
San Francisco • Los Angeles • Seattle • Dow Chemical of Canada, Limited, Toronto, Canada

Ampco Bronze Gears

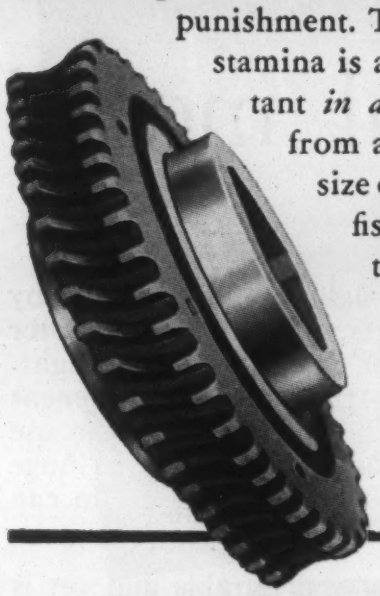


last longer, cut replacement costs

. . . a "common-sense and dollars" reason for making all your gears from Ampco Bronze alloys

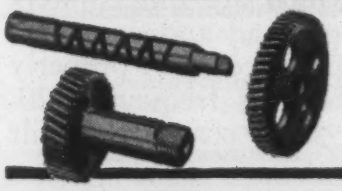
You can count on Ampco Bronze to stand up under the most brutal punishment. This extra stamina is all-important *in any gear*—from a thimble-size drive for a fishing reel to the rolling-mill gear which is illustrated below.

Whether you are designing a new gear or rebuilding old equipment, play safe by selecting the Ampco alloy and form that fit your needs. Get a gear that stands up under impact and fatigue with unbelievable resistance to wear—that outlasts any gear on the same job. Ask your nearest Ampco Field Engineer for recommendations and assistance.



SAND-CAST AMPCO METAL—Massive 2416 lb. worm gear which plays a critical part in the "screw-down" mechanism of a giant size rolling mill.

CENTRIFUGAL CASTING (including teeth)—Used as a boom hoist gear on large excavating shovel. Withstands wear, fatigue, shock, and abrasion caused by dust, dirt, and loading.



EXTRUDED AMPCO METAL—Tiny drive-gears and level-wind gears for a fishing reel; designed to give perfect performance and service under widely varied conditions.

WELDED ASSEMBLY — An Ampco centrifugally-cast ring welded to a mild steel hub and web with Ampco-Trode 10.

***CONTINUOUS-CAST AMPCOLOY—Bronze rim with die cast aluminum hub and web. This eccentric gear is proving its value by giving long, satisfactory service in many automatic home washers—and at a savings to the manufacturer.**

*Produced by American Smelting and Refining Co. under a patented process.

G-1

Ampco Metal, Inc.

West of the Rockies it's the Ampco Burbank Plant, Burbank, Calif.

TEAR OUT THIS COUPON AND MAIL TODAY!

Detailed information on Ampco Metal and Ampco Bronze alloys

AMPCO METAL, INC. Dept. MA-10 Milwaukee 4, Wis.
Please send me a free copy of your Bulletin 95.
Name ..... Position .....
Company .....
Street Address .....
City ..... ( ) State .....

New Materials and Equipment

to approximate size and finished by tooling or grinding to very close tolerances.

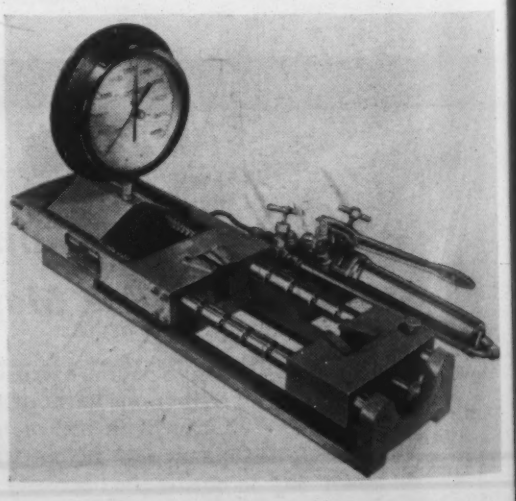
Purebon No. 5 has been used in DDT pumps, ice cream and drink dispensers, oven conveyors and casters, and as bearings in meters, clocks, timers and similar small apparatus.

● Permabrasive, a new softer shot and grit for metal cleaning which reduces wear on machines and parts, has been announced by *Hickman, Williams & Co.*, sales agents for *National Metal Abrasive Co.*, Cleveland, Ohio. Special treatment of the carbon is used to provide a more malleable body which is said to retain its original impact value longer and thereby extend its useful life.

Hydraulic-Operated Portable Tensile Machine Tests Pipe Welds

Steel City Testing Machines, Inc., Detroit, Mich., has announced a new portable tensile testing machine for making field tests where conventional testing equipment is not available.

Known as Model PO-40 Portable Tensile Tester, the machine is particularly adapted



The Model PO-40 Portable Tensile Tester is used primarily for field tests.

for testing pipe welds and other types of welds where on-the-job testing is preferable.

The hydraulic-operated machine has a capacity of 40,000 lb. and will handle specimens 6 to 13 in. in length and up to ⅜ in. thick and 2¼ in. wide.

What's the *right* X-Ray film?

Product:
Gear housing

Material:
Magnesium

Thickness:
Walls varying $\frac{1}{4}$" to 1"

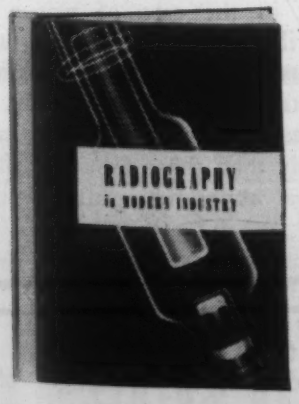
Equipment:
140-kv X-ray unit

ANSWER:

KODAK INDUSTRIAL X-RAY FILM, TYPE M

In a light alloy casting such as this, the radiographer is interested in discovering microporosity, as well as other irregularities that might be present. This requires the highest possible visibility of detail.

Therefore, Kodak Industrial X-ray Film, Type M, is chosen because this film has the highest contrast and finest graininess of all x-ray films.

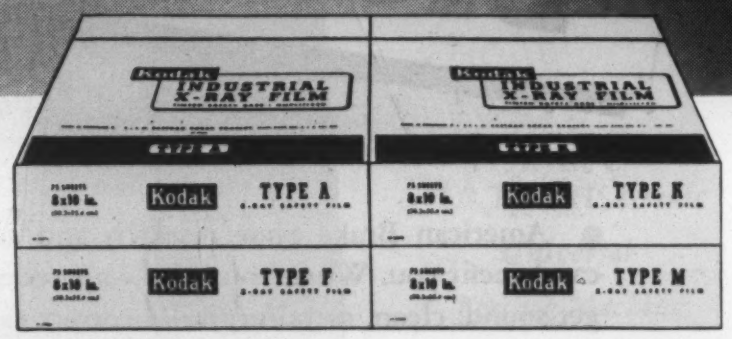


RADIOGRAPHY IN MODERN INDUSTRY

A wealth of invaluable data on radiographic principles, practices, and technics. Profusely illustrated with photographs, colorful drawings, diagrams, and charts. Get your copy from your local x-ray dealer—price $3.

Radiography . . .

another important function of photography



A TYPE OF FILM FOR EVERY PROBLEM

To provide the recording medium best suited to any combination of radiographic factors, Kodak produces four types of industrial x-ray film.

Type M provides maximum radiographic sensitivity, high contrast, and exceptional detail under direct exposure or with lead-foil screens. It has extra fine graininess, and the speed is adequate for examination of light alloys at average kilovoltage and for much million-volt radiography.

Type A offers high contrast with about three times the speed of Type M, but with slightly more graininess. Used direct or with lead-foil screens for study of light alloys at low voltages, and of heavy steel parts with 1000-kv x-rays or radium.

Type K has medium contrast with high speed. For gamma ray work and for x-ray work where highest possible speed is needed at available kilovoltage without use of calcium tungstate screens.

Type F provides the highest available speed and contrast when exposed to x-rays with calcium tungstate intensifying screens. Has wide latitude with either x-rays or gamma rays, exposed directly or with lead-foil screens.

EASTMAN KODAK COMPANY
X-ray Division · Rochester 4, N. Y.
"Kodak" is a trade-mark

Kodak

HEAT-
CORROSION-
ABRASION-
RESISTANCE

...OR
MACHINABILITY
IN

CASTINGS

by

Brake Shoe

● American Brake Shoe research and advanced foundry techniques can benefit you. When you refer your requirements to Brake Shoe, you get sound, clean, metallurgically correct castings, and machined rejects are low. You also receive the advantage of impartial recommendations as to metal types, such as:

Meehanite® — a series of controlled irons in 3 general groups to meet specific requirements; general engineering, heat resistant, corrosion resistant.

ABK Metal — a premium grade alloyed iron with outstanding abrasion resistance.

Engineered Gray Iron — a series of engineering cast irons with controlled properties and good machinability.

At Brake Shoe's large and well-equipped production foundries in Mahwah, N. J., Melrose Park, Ill., and Baltimore, Md., castings of widely used types can be made — light, medium or heavy weight, green or dry sand, or all core assemblies — as well as difficult or special purpose types.

Whatever your present or future needs for cast parts may be, send your specifications to Brake Shoe for expert recommendations.

AMERICAN Brake Shoe COMPANY

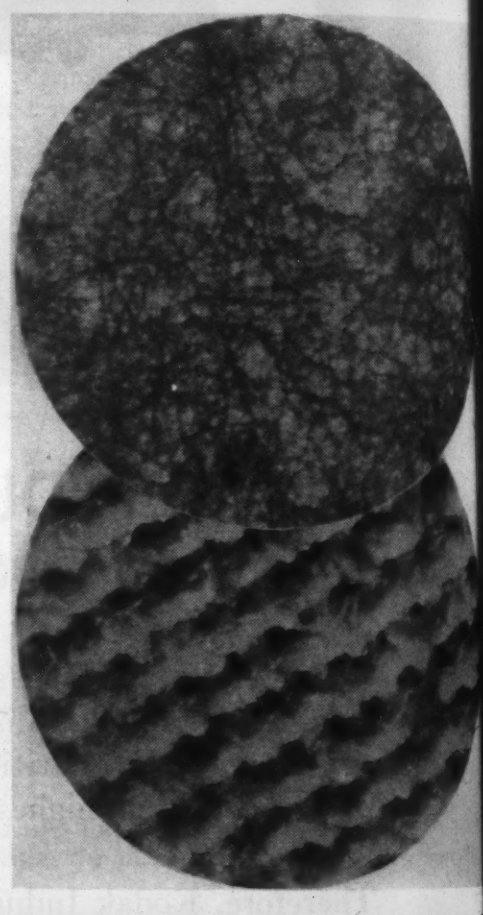
BRAKE SHOE AND CASTINGS DIVISION
230 PARK AVENUE, NEW YORK 17, N. Y.

New Materials and Equipment

New Matted Filler Increases Strength of Phenolic Laminates

Production of a new laminated phenol plastic with exceptionally high impact f tigue valves and excellent machinability h been announced by *Synthane Corp.*, Oak Pa.

These properties are attributed to the u of a cotton mat filler whose random fibe



Texture of the new filler in Synthane Grad L-RF (full circle) is shown in contrast the woven fabric used in Grade C.

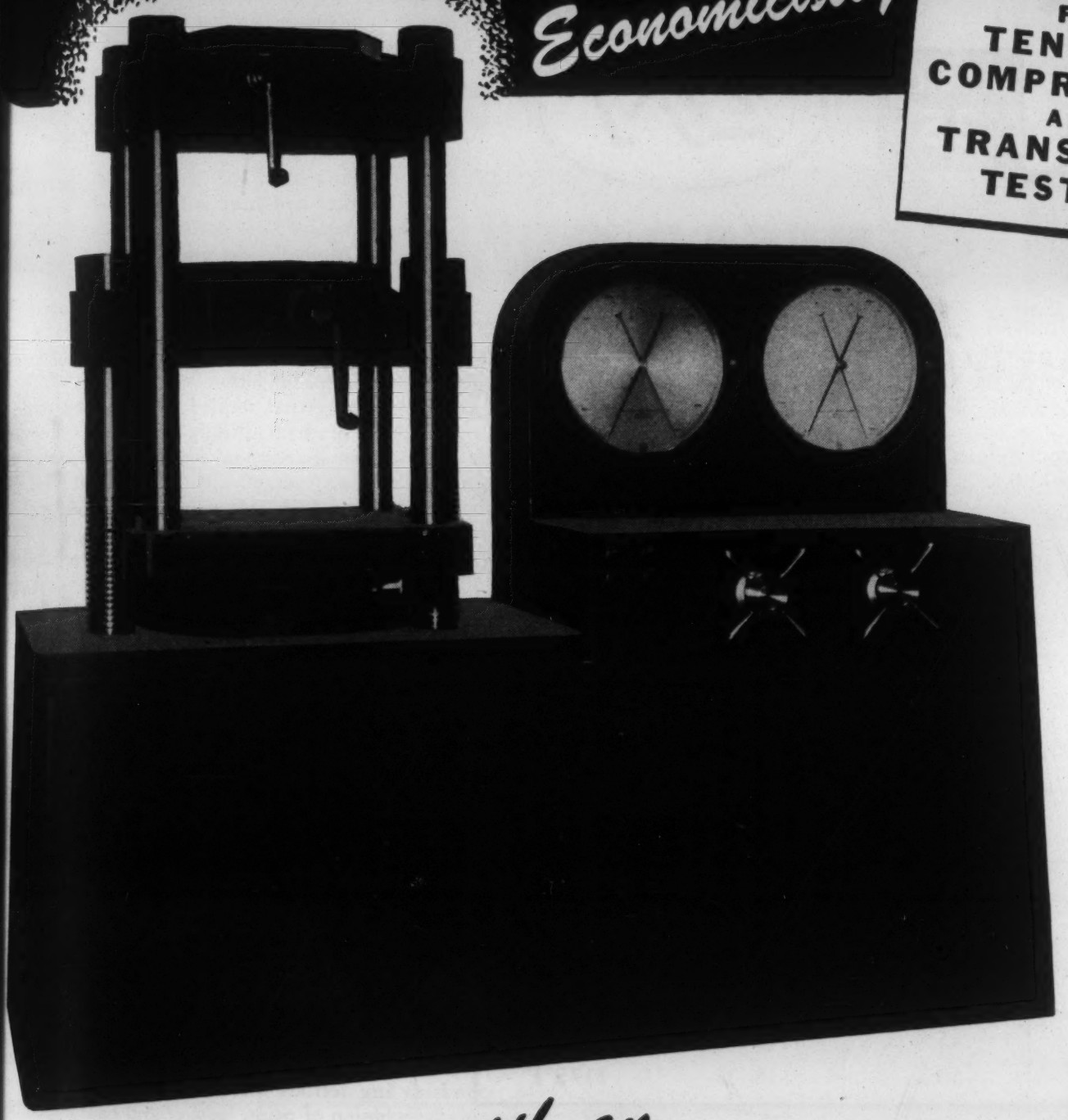
lie in all directions rather than in paralle planes, as in the case of woven fabric Even distribution of the matted, unwove cotton fibers give the new Grade L-R uniform strength in all directions. Conse quently, parts made from this material wea more evenly than those fabricated from th conventional woven-fabric-filler plastic lam nates.

In flatwise impact fatigue tests conducte by Synthane Corp., Grade L-RF resiste 5000 blows compared to 50 for Grade and 100 for Grade C. Average tensile flexural and compressive strengths of Grad L-RF easily exceed the NEMA averages fo Grades L and C.

Grade L-RF is available in tan or blac in standard 36- by 36-in. sheets of thick nesses from 1/32 to 2 in., and 36-in. ro lengths ranging in diameter from 3/3 to 1½ in.

10 YEARS HAVE PROVED
YOU CAN HAVE A COMPLETE TESTING LABORATORY
Economically

FOR TENSION, COMPRESSION AND TRANSVERSE TESTING



Olsen 400,000 lb. "L" Type Hydraulic Universal Testing Machine

with an

Write for complete information

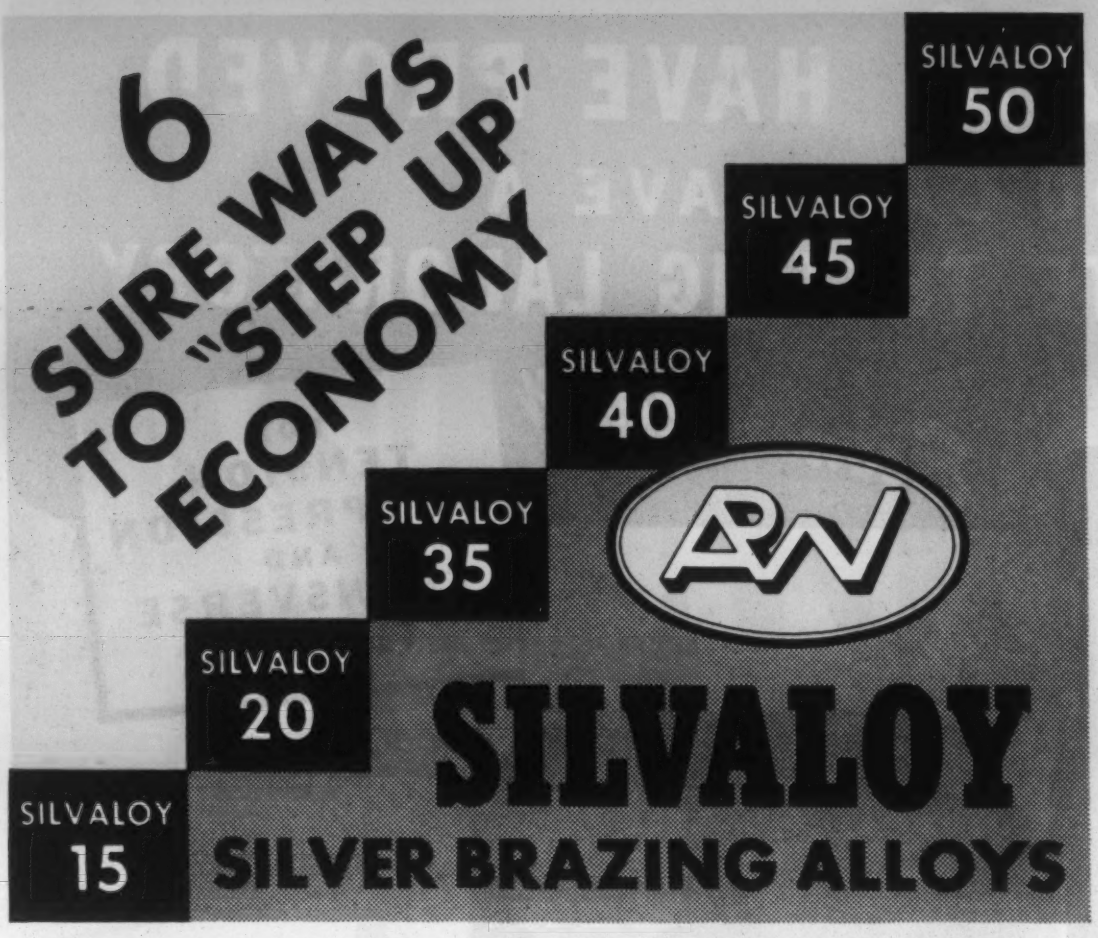
- **OLSEN "L" TYPE HYDRAULIC UNIVERSAL TESTING MACHINE**
- **OLSEN MECHANICAL EXTENSOMETER**
- **OLSEN COMBINATION 1" TO 2" GAGE PUNCH**
- **OLSEN "RAPID-ACTION" PERCENTAGE SCALE**

TINIUS OLSEN
Testing & Balancing Machines

TINIUS OLSEN TESTING MACHINE CO.
2010 Easton Rd., Willow Grove, Pa.

Available in 60,000, 120,000, 300,000 and 400,000 pound capacities each Olsen "L" Type Universal has an additional range of 1/5 or 1/6 capacity. No other testing equipment can give this accurate, dependable and convenient service at such a *low cost!*

Visit the Metal Show . . . October 17th to 21st . . . Cleveland, Ohio



This year's National Metal Exposition has taken as its theme "Economy in Production". In line with this, low temperature silver brazing is frequently the economical answer to many assembly problems.

SILVALOY, the silver brazing standard in industry, may be able to do your job more economically. SILVALOY 15 is a silver-copper-phosphorous alloy, in nation-wide use, for brazing copper and copper alloys. The five other SILVALOY alloys are quaternary silver-copper-zinc-cadmium alloys which meet industry's demand for better, more practical, silver brazing.

SILVALOY means better quality, better results

ALLOY NO.	SILVER CONTENT	MELTING POINT	FLOW POINT
SILVALOY 15	15%	1185°F	1280°F
SILVALOY 20	20%	1430°F	1500°F
SILVALOY 35	35%	1125°F	1295°F
SILVALOY 40	40%	1135°F	1205°F
SILVALOY 45	45%	1125°F	1145°F
SILVALOY 50	50%	1160°F	1175°F

ALSO, A WIDE VARIETY OF OTHER SILVER SOLDERS FOR SPECIAL APPLICATIONS

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Refiners and Manufacturers
PRECIOUS METALS SINCE 1875
231 NEW JERSEY R. R. AVENUE
NEWARK 5, N. J.

New Materials and Equipment

Heavy-Duty Hydraulic Lathe Handles Wide Variety of Work

Production of a versatile, heavy-duty vertical hydraulic lathe has been announced by *Snyder Tool & Engineering Co.*, Detroit.

Originally designed for a large manufacturer of car and truck components, this machine is said to be widely adaptable to facing, boring or turning a variety of large work pieces simply by changing the fixtures and tool holders.

A vertical welded steel column carries a 21-in. hydraulically operated, horizontal cross slide upon which are mounted two 14-in. hydraulically operated vertical tool slides. Each tool slide is equipped with tee slots and key ways for mounting tool blocks and holders. A 30-in. variable speed rotating table is mounted on the base and is equipped with tee slots and pilot for mounting fixtures or chucks. Table speeds from 46.5 to 185 rpm. are available. The machine can be set for various combinations of automatic cycling.

● An acid-type cleaning and surface-conditioning material, Oakite Compound No. 33, has been announced by *Oakite Products, Inc.*, 132 H Thames St., New York, N. Y. Good detergent and solvent properties make the new compound suitable for removing rust, oxides, grease, oils and shop soils from metal surfaces, and for preparing ferrous metals and aluminum for adhesion of paint, lacquer and enamel finishes.

New Tester for Small Springs Designed for High Production

A spring testing machine designed for high production inspection and testing of any type of small spring within the limits of 12 in. in length and 5 lb. of load is being manufactured and sold by the *Testing Equipment Dept.* of the *Baldwin Locomotive Works*, Philadelphia 42. It was developed by the *Hunter Spring Co.*, Lansdale, Pa.

The tester was designed especially for springs made of wire sizes from 0.005 to 0.030 in. in dia. The equipment is sensitive

For ALUMINUM
that gives you more and can cost you less . . .

THERE ARE many reasons why it's to your advantage to look to us for all your aluminum needs. Here are a few of them:

1. **You get Reynolds Lifetime aluminum that's guaranteed as to uniformity of size and thickness; of alloy, temper, and other physical characteristics.**
2. **You know that you are obtaining your aluminum from a well-known, dependable source.**
3. **You have the assurance that your aluminum will be packaged carefully. Thus, the contents will arrive undamaged—without water stains, bending of material, injury to corners, or surface scratches.**
4. **You have the additional valuable advantage of our metallurgical advice and assistance in problems of application.**

And, what's very important, we can show you how it can cost you less when you place your orders for aluminum with us. So, whenever you need aluminum, remember that your best source of supply is United States Steel Supply. For prompt, courteous service, just phone, wire or write the warehouse or sales office nearest you.

UNITED STATES STEEL SUPPLY COMPANY · STEELS · SERVICE

SYMBOL OF SERVICE

UNITED STATES STEEL SUPPLY COMPANY

Warehouses: BALTIMORE · BOSTON · CHICAGO
CLEVELAND · LOS ANGELES · MILWAUKEE · MOLINE, ILL. · NEWARK · PITTSBURGH
PORTLAND, ORE. · SAN FRANCISCO · SEATTLE · ST. LOUIS · TWIN CITY (ST. PAUL)
Also Sales Offices at: KANSAS CITY, MO. · PHILADELPHIA · TOLEDO · TULSA · YOUNGSTOWN
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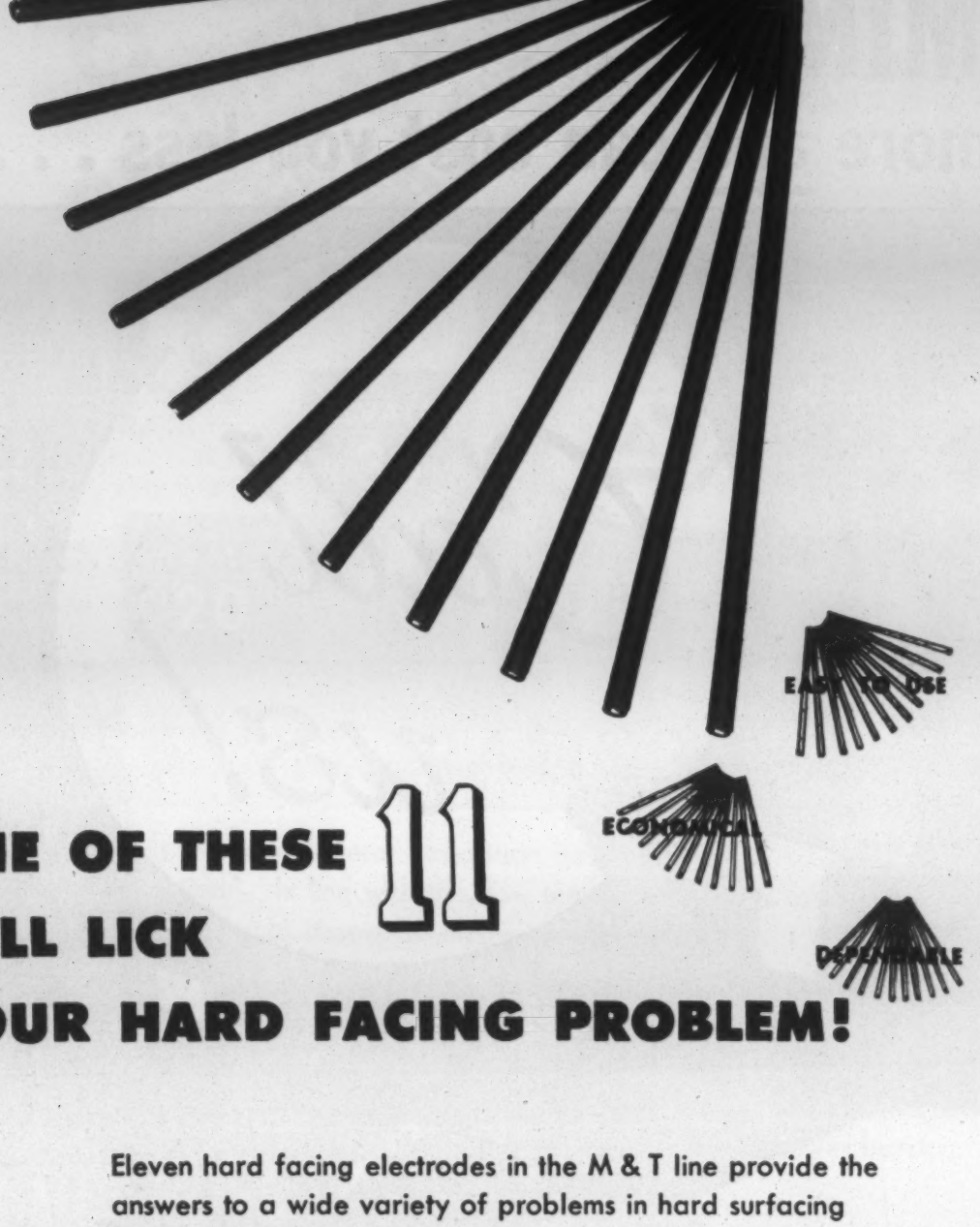
USS

UNITED STATES STEEL



ONE OF THESE 11 WILL LICK YOUR HARD FACING PROBLEM!

Eleven hard facing electrodes in the M & T line provide the answers to a wide variety of problems in hard surfacing and building up of worn parts.

The Hardex group—four easy to use low alloy rods which operate and perform like mild steel electrodes provide low cost hard facing where required hardnesses are from 200 to 600. Deposits are air hardening. Qualities may be altered by heat treating.

The five Aluminum Bronze and two Tool Steel electrodes are for special applications such as building up or facing bearings, tools and dies.

Write for descriptive data.

M & T Hard Facing electrodes are members of the "Select 70"—a group of seventy outstanding electrodes offered by M & T—along with M & T AC and DC welding machines and M & T accessories—to give you everything needed for arc welding—arc welding of top-notch quality.

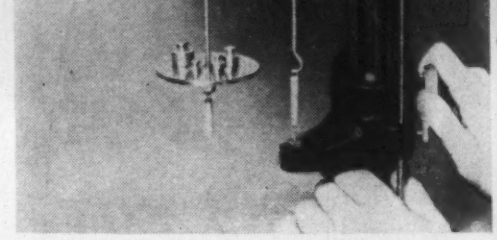
METAL & THERMIT CORPORATION

120 Broadway • New York 5, N. Y.

New Materials and Equipment

to load changes of less than 50 mg. and has a weighing accuracy within ±0.10%.

When set for a required load and a given extension or compression of spring, a pointer amplifies weighing beam motion ten times and indicates on a curved scale the force applied by the spring, or whether or not the spring is within design tolerance



This Baldwin-Hunter tester will supply loads up to 5 lb. and will accommodate springs up to 12 in. in length.

limits. Vernier adjustments of compression and extension heads also allow accurate determination of compressed or extended lengths of springs for a given load. These measurements are made on a dial indicator which is accurate to ±0.001 in.

The instrument is faster than conventional load measuring equipment and is expected to eliminate inaccuracies of improvised special testing jigs.

New Deep-Hardening Speed Steel Available as Hot Rolled Plate

A new speed steel possessing high hardenability and, therefore, applicable for use where relatively high compressive strengths are required has been announced by *W. J. Holliday & Co.*, Indianapolis, Ind. The new alloy is available as hot rolled plate in widths up to 72 in. and thicknesses to 6 in.

Designed to bridge the gap between carbon and tool steels, Speed Alloy depends for its deep hardening properties on chromium and molybdenum additions to a 0.30 to 0.35% carbon steel base. The new speed alloy is essentially oil hardening and

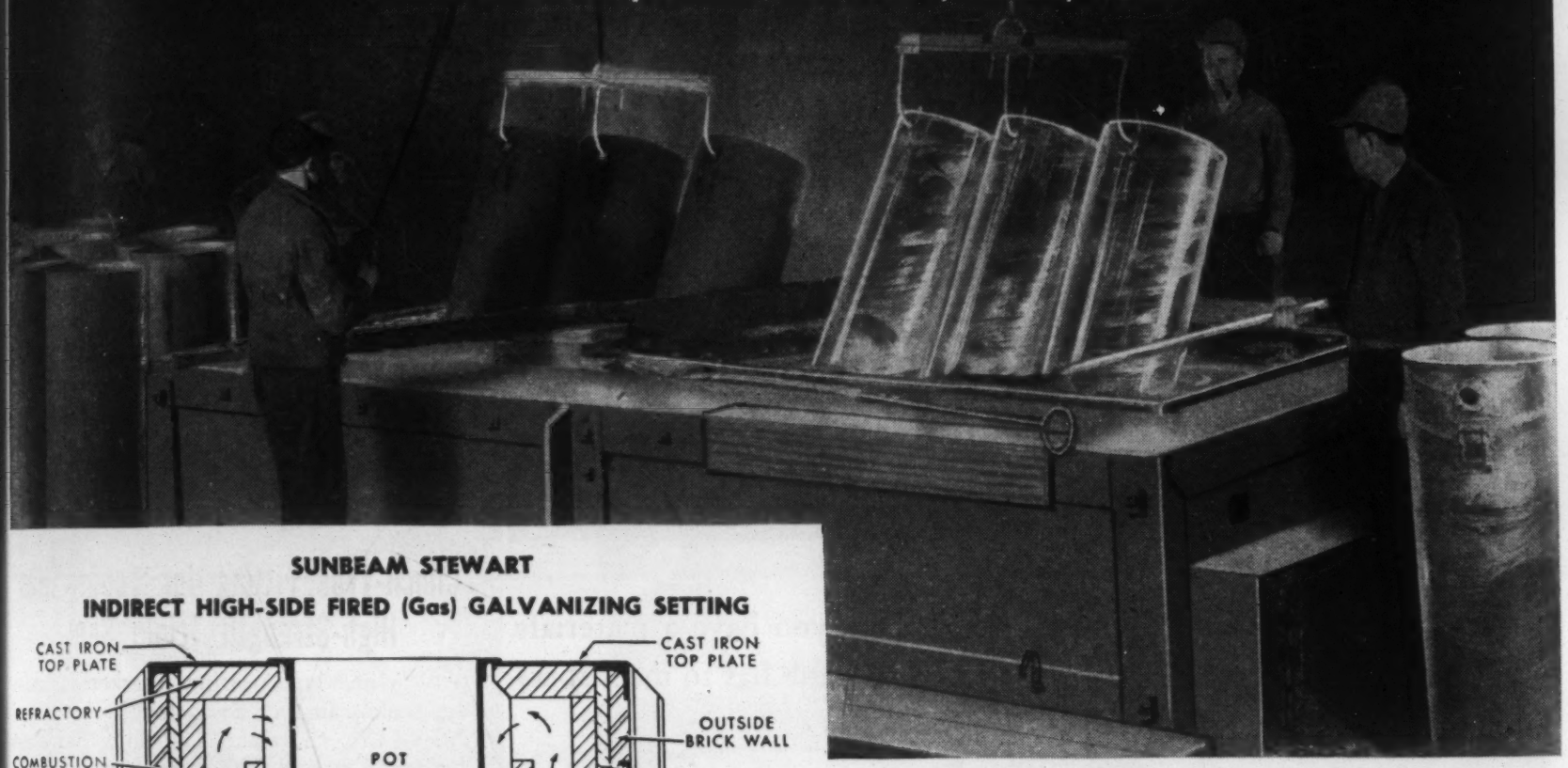
No. 95 of a Series of Typical Installations

Sunbeam STEWART

THE BEST INDUSTRIAL FURNACES MADE

GALVANIZING WATER HEATERS

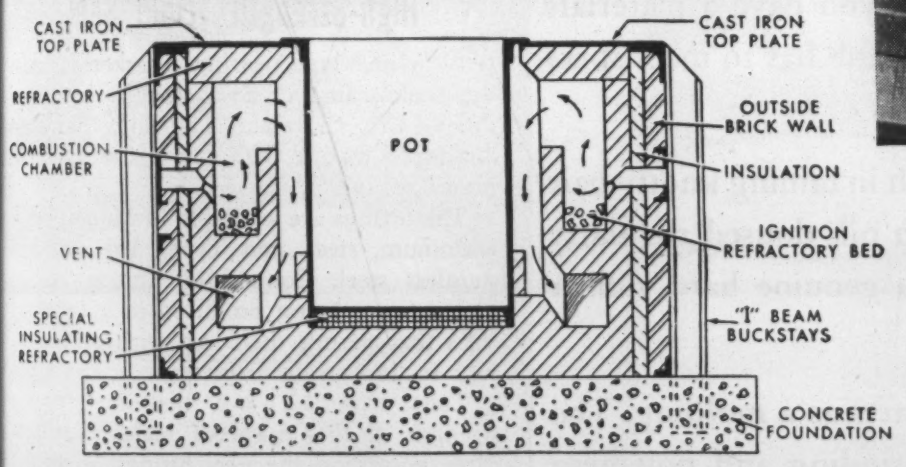
At A. O. Smith Corporation, Kankakee, Illinois, Works



Sunbeam Stewart Galvanizing Equipment at A. O. Smith is in operation 8 hrs. per day, plus, depending upon manufacturing schedules. 500 sets (shell, 2 heads, 1 flue) are processed per shift.

SUNBEAM STEWART

INDIRECT HIGH-SIDE FIRED (Gas) GALVANIZING SETTING



Improved design and correct engineering have made Sunbeam Stewart the leader for galvanizing equipment. Burners fire against a protective baffle and provide a uniform flow of hot combustion gases to the upper part of the kettle. The gases travel downward to a point slightly above the dross where they are exhausted. This principle of High-Side Firing provides close temperature control and even heat distribution. Available for gas or oil fuel. This type of design assures:

1. **UNIFORM BATH TEMPERATURE**
2. **LOW DROSS LOSS**
3. **MAXIMUM PRODUCTION RATE**
4. **LOW FUEL CONSUMPTION**
5. **LONG KETTLE LIFE**

This is Number 95 in a series of typical installations showing how Sunbeam Stewart furnaces are helping manufacturers reduce their costs and keep themselves competitive. These installations also demonstrate the wide variety of specific requirements in the metal-working industry Sunbeam Stewart furnaces are designed to meet.

A. O. Smith is one of many satisfied users of Sunbeam Stewart galvanizing furnaces. Quality of work and low cost of maintenance and operation are key factors in Sunbeam Stewart's design that have proved their worthiness year after year. Users report dross loss as low as 5% and kettle life up to 6 years. If galvanizing is important in your manufacturing process, it will pay to consult Sunbeam Stewart. Designs are available for small or large production. We will be glad to submit ideas on how you can get more economical operation.

SUNBEAM STEWART INDUSTRIAL FURNACE DIVISION of SUNBEAM CORPORATION

(Formerly **CHICAGO FLEXIBLE SHAFT CO.)**

Main Office: **Dept. 111, 4433 Ogden Ave., Chicago 23** — *New York Office:* **322 W. 48th St. New York 19** — *Detroit Office:* **3049 E. Grand Blvd., Detroit**
Canada Factory: **321 Weston Rd., So., Toronto 9**

A letter, wire or 'phone call will promptly bring you information and details on SUNBEAM STEWART furnaces, either units for which plans are now ready or units especially designed to meet your needs. Or, if you prefer, a SUNBEAM STEWART engineer will be glad to call and discuss your heat treating problems with you.

if you COMBED your hair this morning

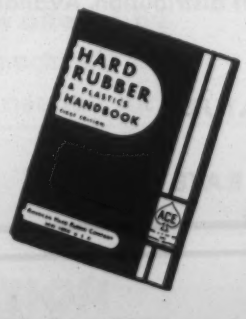
YOU HAVE THE ANSWER TO MANY TOUGH MATERIALS PROBLEMS

If you use an Ace *hard rubber* comb, you have a materials testing lab right in your pocket, for a good comb has to meet specs that are *tough!*

It's light and thin, but shows amazing strength in taming knotty hair and surviving 6-ft. falls. It gets covered with oil, doused regularly in hot water and sterilizing chemicals, yet a genuine hard rubber comb lasts for years.

It's a good example of fabricating, too. It starts as a molding. The teeth are machine-cut. Finally, a series of grinding and polishing operations give it that smooth, satiny feel.

Best for nearly 100 years, there still is no other material as good for combs. It shows you why Ace hard rubber is preferred in thousands of parts for machines, appliances, automobiles, furniture, etc. Other important Ace plastics also available.



Write for helpful Ace Handbook

ACE AMERICAN HARD RUBBER COMPANY
HARD RUBBER and OTHER IMPORTANT PLASTICS
Since 1851
11 MERCER STREET • NEW YORK 13, N. Y.

New Materials and Equipment

affords surface hardnesses up to 400 Bhn., depending upon the section. It is easily carburized.

Typical mechanical properties of the regular stock plate are as follows:

Tensile Strength	104,000 psi.
Yield Strength	65,000 psi.
Elongation (2 in.)	26.0%
Reduction in Area	57.0%
Hardness	207 Bhn.

Speed Alloy is claimed to be the most economical alloy mold and die plate available. Its wide range of obtainable mechanical properties makes it suitable for a great number of other applications, including zinc die castings and machined parts such as cams, gears, racks, ways, platens and yokes.

Clinch-Type Fitting for Tubing Has High-Strength Triple Seal

A "clinch-type" fitting, marketed under the trade name of Swagelok by *Crawford Fitting Co.*, Cleveland 17, Ohio, has been developed for use with any type of metal or plastic tubing.

The fittings are available in Monel, brass, aluminum, steel, and Types 303 and 316 stainless steel. Connectors, unions, elbows and tees are being produced in a range of sizes that permit their use with tubing ⅛ to 1 in. in outside diameter.

Tests have shown that the rupture strength of the leakproof seals, located at three points on the new fittings, is greater than that of tubing. Yet the two ferrules and threaded chuck clamp around the tube with virtually no effect on the inner walls, leaving the flow of liquids or gases unimpeded. In addition, the axial support which Swagelok fittings lend to a tube assembly tends to drive vibration away from the fitting, thereby minimizing fatigue.

Swiss Precision Jig Grinder Has 5-In. Grinding Diameter Capacity

A precision jig grinder having a capacity grinding diameter of 5 in. is being made available by *Hauser Machine Tool Corp.*, Manhasset, N. Y. The new grinder, Model 3S, is one of a line developed by Henri Hauser, Ltd., Bienne, Switzerland.

(Continued on page 128)

Improve FORMED *Products*

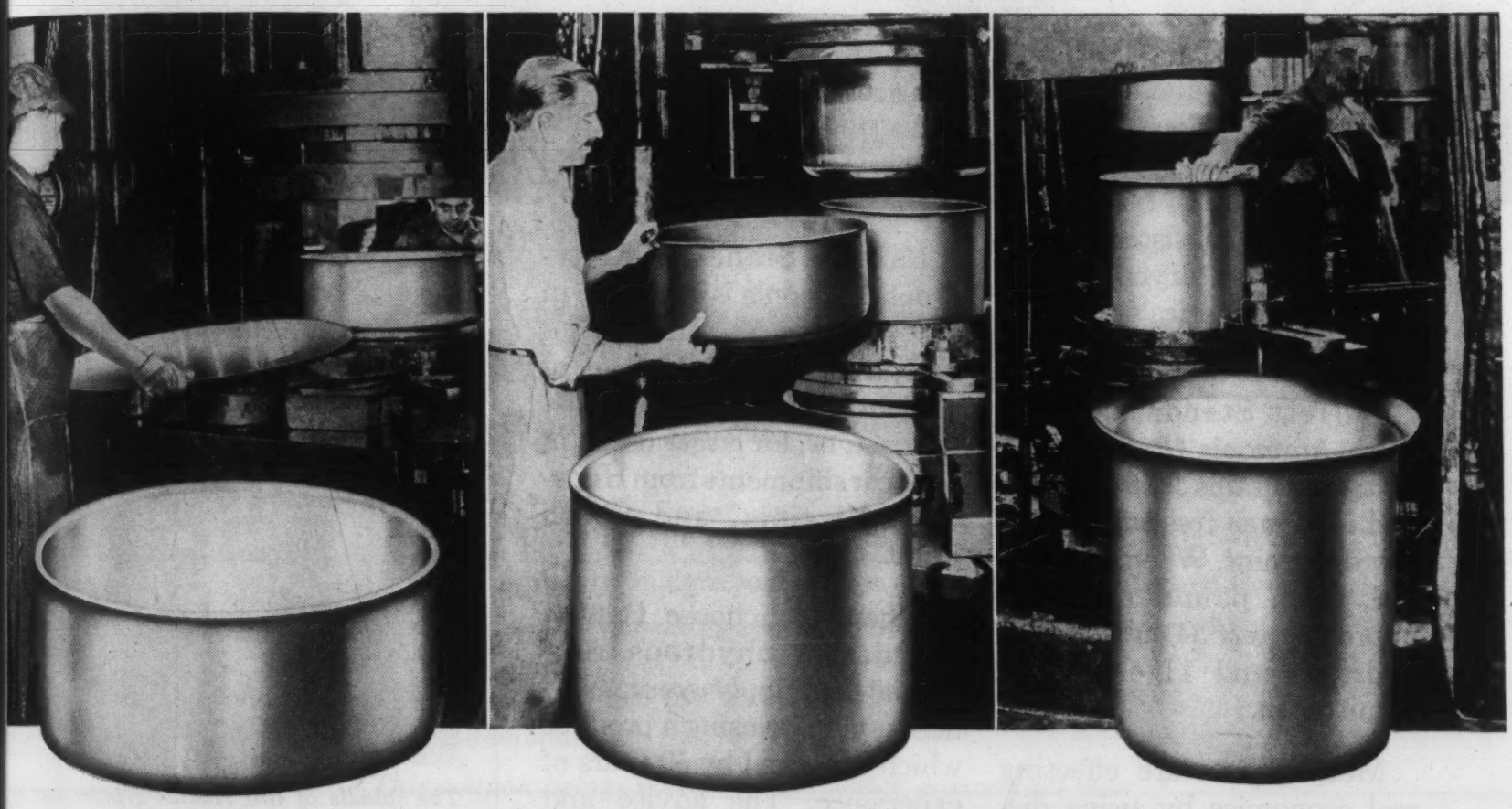
BY USING DEEP DRAWING STAINLESS STEEL

To fabricators of austenitic CHROMIUM-NICKEL stainless steel the properties of this metal offer:

- **Ability to take severe deformation without rupturing.**
- **Ability to retain toughness despite a deep draw. Final stress relief may often be omitted.**
- **Ability to provide smooth, corrosion-resistant surfaces, easy to clean and keep clean.**
- **Ability to cut bulk and deadweight from a product without sacrificing strength or durability.**

Products formed of these silvery white steels impress one instantly with their beautiful "stainless" satin finish that adds to their sales value.

Leading steel companies produce austenitic chromium-nickel stainless steels in all commercial forms. A list of sources of supply will be furnished on request.



THREE STEPS IN DEEP DRAWING 10-GALLON STAINLESS STEEL STOCK POTS

Lalance and Grosjean Mfg. Co., Woodhaven 21, New York, producers of Crusaderware, start with a circular blank of stainless steel .056" thick, such as the man holds, at the left. First draw produces the form pictured above.

The second draw results in the above part. Hydro-Dynamic Presses, produced by E. W. Bliss Company of Detroit, are used for both first and second draw. They provide controlled speed and pressure at full length of stroke.

A mechanical double-action press makes the final draw, and the resulting product comes out with a beautiful, smooth surface that resists corrosion, wear, impact and abrasion.

Don't Forget...

Jot down—"INCO Booth, No. 302"—in your memo book of companies to visit at the **NATIONAL METAL EXPOSITION,** at the Public Auditorium in Cleveland, Ohio, October 17th to 21st. Convenient facilities for discussing your problems with our metallurgists and foundry specialists will be available.

INCO BOOTH NO. 302

THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET
NEW YORK 5, N. Y.

59 YEARS OF NH_3 EXPERIENCE

BARRETT Standard Anhydrous Ammonia was first manufactured in 1890. During the last 59 years, its dependable quality, consistent purity and uniform dryness have made it America's leading source of NH_3.

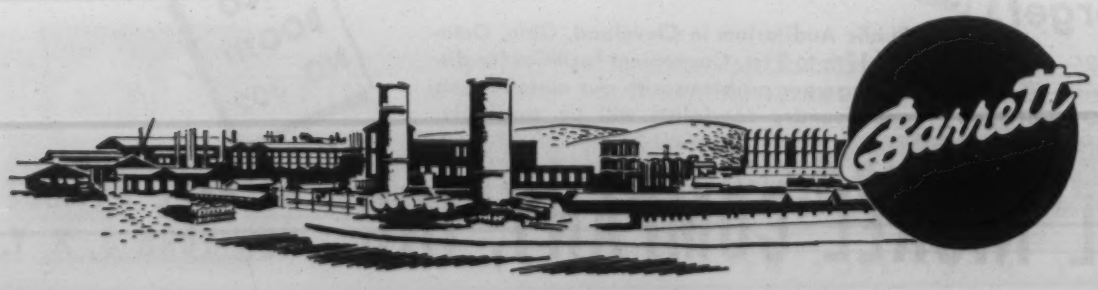
Barrett Standard Anhydrous Ammonia (*Refrigeration Grade*) contains 99.95% NH_3 and is oxygen free with a very low dew point. When dissociated, each pound produces approximately 34 cubic feet of hydrogen and 11 cubic feet of nitrogen.

Metallurgists are effecting real economies by using dissociated ammonia in the production of controlled atmospheres in furnaces for bright annealing, clean hardening, copper brazing, sintering, reduction of metallic oxides, atomic hydrogen welding, radio tube sealing and other metal-treating practices. Anhydrous ammonia also has unsurpassed qualities in nitriding of steel, used as ammonia gas or dissociated.

Barrett Standard Anhydrous Ammonia is available in 150, 100 and 50-pound cylinders from stock points conveniently located from coast to coast; or, for larger users, in tank car shipments from Hopewell, Virginia, and South Point, Ohio.

When you choose Barrett Standard Anhydrous Ammonia to supply your NH_3 needs, you are using a product which is backed by 59 years of experience. The advice and help of Barrett technical men are available to Barrett customers without charge. Free literature will be mailed on request.

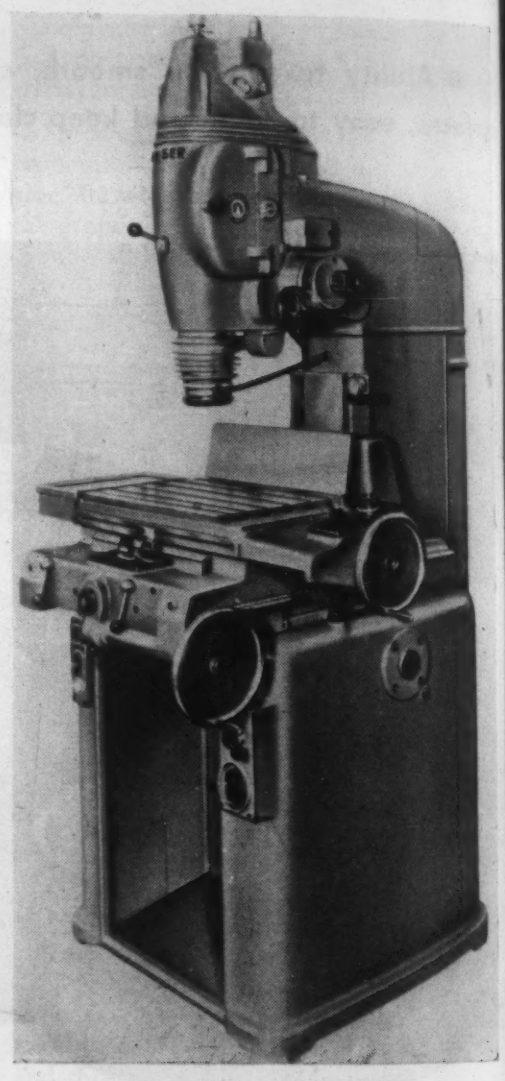
THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.



New Materials and Equipment

The working surface of the grinder table is 22 by 12¾ in., with a longitudinal travel of 16 in. and transverse travel of 10 in. The compressed-air-driven interchangeable spindle unit can be run at speeds up to 75,000 rpm.

Small and medium size holes are ground



The spindle of this Hauser grinder can be driven at speeds up to 75,000 rpm.

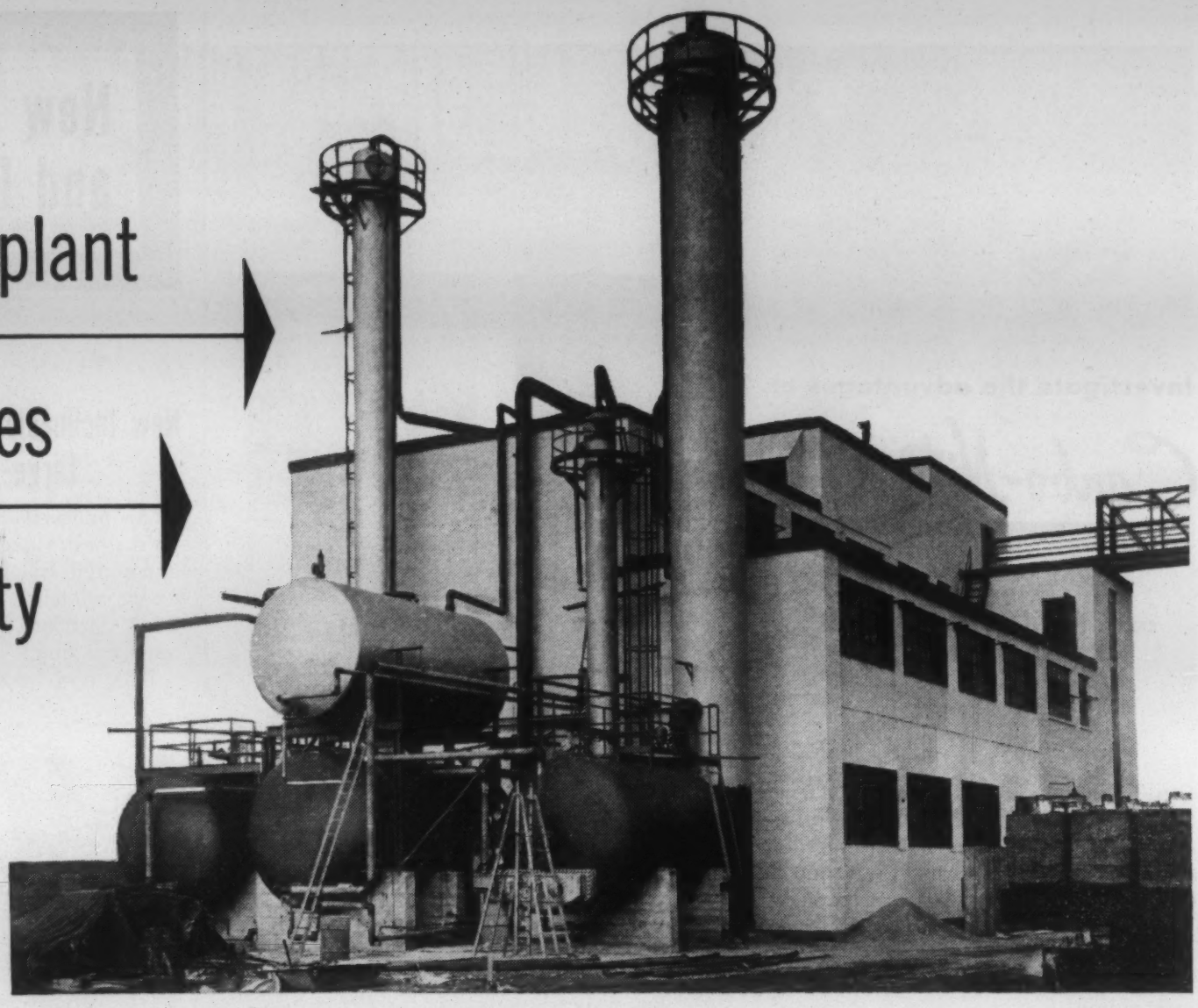
with the normal high-speed spindle; larger holes, up to 5 in. in dia., are ground using a special set-off grinding head with eccentric adjustment. Provision is made for grinding taper holes with an included angle up to 3° on a length of 2 5/16 in. and with somewhat smaller angles for lengths up to 3 9/16-in. vertical travel of the spindle.

● Stepless spindle speeds from 32 to 2000 rpm. are now available on the Model 8A precision lathe manufactured by *Wade Tool Co.*, Waltham, Mass. With the back gears engaged, the stepless spindle speeds range from 32 to 220 rpm. This machine is claimed to be the only one with 1-in. collet capacity and 8½-in. swing which embodies this design feature.

this new plant

assures

quality



NIALK TRICHLORethylene

Are you looking for a thoroughly dependable source of supply for trichlorethylene?

Niagara's new plant for the production of NIALK TRICHLORethylene is completely modern and makes use of special control equipment to satisfy the most exacting requirements for quality and stability.

It is designed to permit increased production facilities— to meet expanding demands.

This coupon brings you a booklet which answers all your questions about NIALK TRICHLORethylene and Niagara Alkali Company. Fill in and mail today.

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, New York

Liquid Chlorine · Caustic Potash
Carbonate of Potash
Paradichlorobenzene
Caustic Soda
NIALK TRICHLORethylene

Niagara Alkali Company, Dept. F,
60 East 42nd Street, New York 17, N. Y.

Gentlemen: Please send me a copy of your booklet on NIALK TRICHLORethylene.

Name_____

Position_____

Firm_____

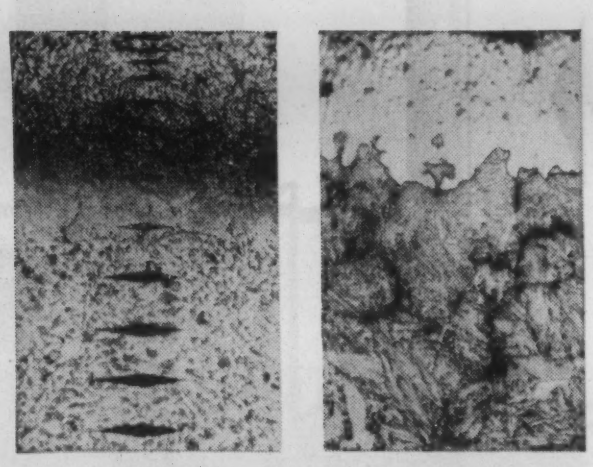
Street_____

City_____ State_____

Investigate the advantages of

Carbo-Nitriding

over your present case hardening methods



100X 500X

Microstructure of specimens carbo-nitrided for four hours at 1500°F., quenched in oil.

Carbo-Nitriding is one of the most efficient methods of surface hardening iron-base alloys. Compared with liquid cyaniding and carburizing it offers many advantages:

- Carbo-Nitriding is readily adaptable to mass production methods. In many cases costs may be reduced to approximately ⅓ to ½ the cost of liquid cyaniding.
- Carbon and nitrogen concentrations can be controlled.
- Washing and cleaning operations are reduced and simplified . . . working conditions are cleaner and safer.
- Because lower quenching rates can be used . . . distortion and cracking is reduced; plain carbon steels may be substituted for alloy steels.
- More uniform cases are produced. An even case can be produced on free-machining screw stock.
- Because lower operating temperatures can be used, furnace maintenance is simplified, fuel costs are lowered.
- Carbo-Nitriding imparts resistance to rusting and corrosion.

Because carbo-nitriding is a gas process, most equipment suitable for atmosphere work may be converted for carbo-nitriding at a relatively low cost.

Armour's Technical Service Department is available to assist you in determining the best possible application of carbo-nitriding to your case hardening work. Mail this coupon today for more complete information.

ARMOUR *Ammonia Division*

Armour and Company • 1355 W. 31st St. • Chicago 9, Ill.

Mail this coupon today!

Please send me details on carbo-nitriding in case hardening.

Name.....

Title.....

Firm.....

Address.....

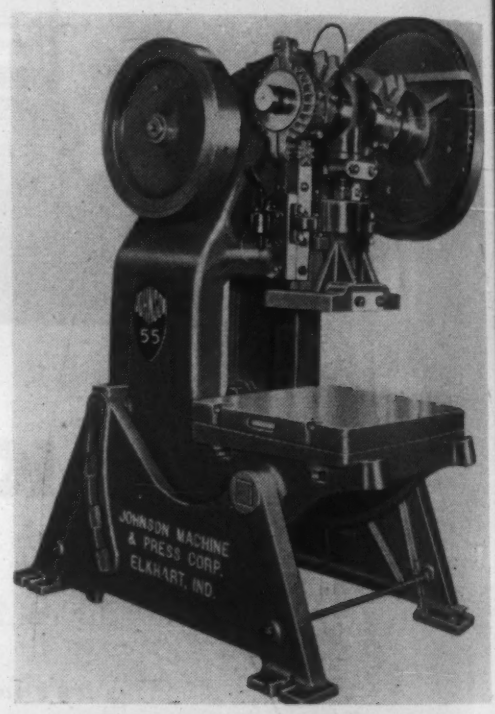
City..... *Zone*..... *State*.....

New Materials and Equipment

New Inclinable Punch Press Provides Large Working Area

An unusually large die space is featured on the new Model 55 inclinable punch press announced by *Johnson Machine & Press Corp.*, Elkhart, Ind. The die space has a 14-in. standard opening and 18-in. maximum opening.

The new model has a 32- by 34-in.



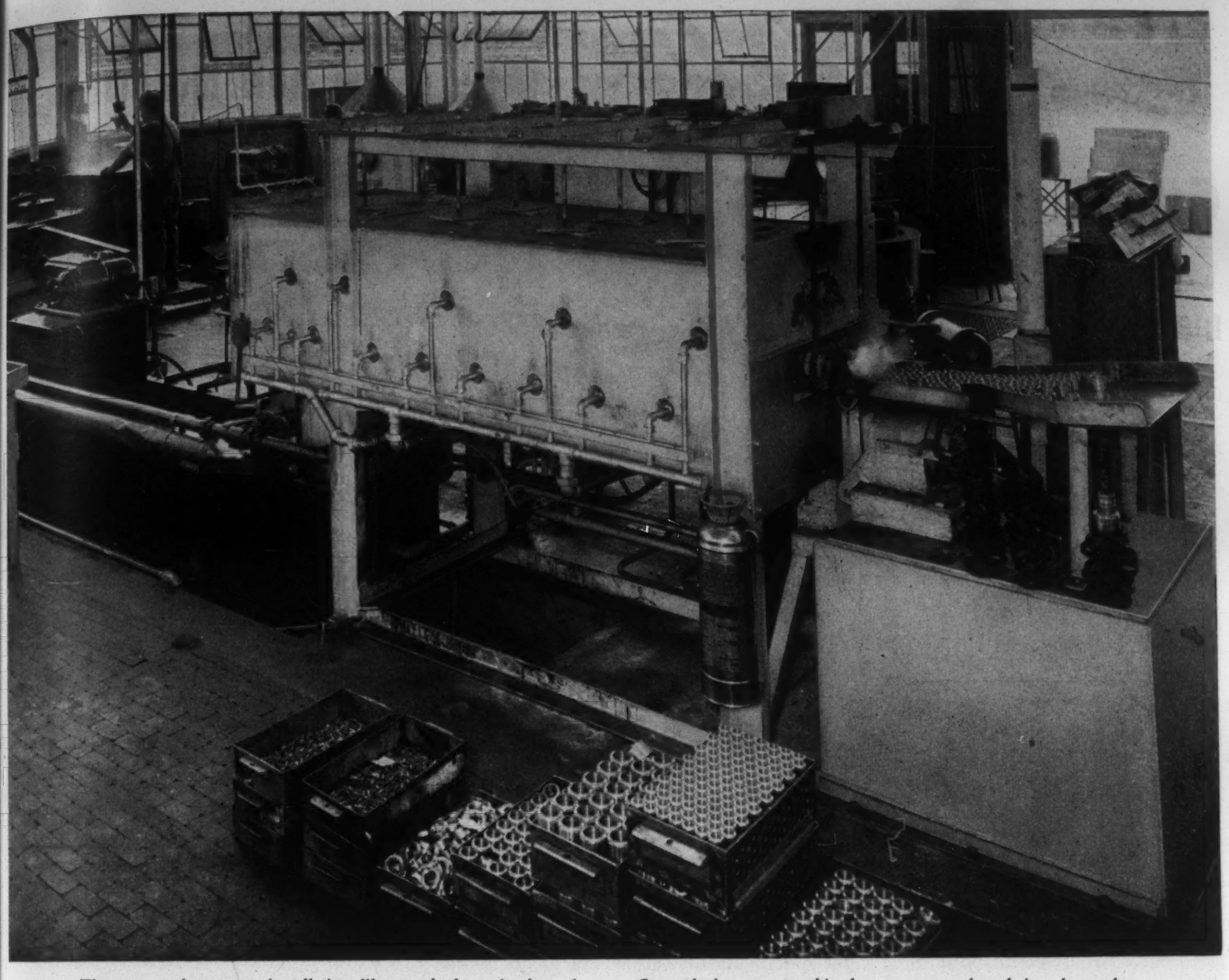
This Johnson punch press has a standard die space opening of 14 in.

bolster plate and a 14- by 18-in. ram face. The press will handle work up to 16¾ in. deep at the rate of 45 pieces per min. either in the vertical position or in tilted positions up to 36°. Use of the press in tilted positions allows the work to drop away without mechanical ejection.

Economy in Punching Small Parts Expected from New Model Press

Benchmaster Manufacturing Co., 2952 West Pico Blvd., Los Angeles, Calif., has announced production of a small model punch press known as the Benchmaster Midget.

The low-cost Midget is designed to handle a great number of small punch press jobs now being handled by machines of greater tonnage than actually required. Use of this press is expected to make it economical for operators to use individual presses for each stage of operations, leaving



The neat and compact installation illustrated above is that of our No. 166 Reciprocating Furnace with Automatic Quench Tank as installed at the Jacobs Manufacturing Company plant for the case hardening and clean hardening of various parts.

One of the reasons this furnace was selected in place of a cyanide bath, the method previously employed, was that it eliminated the difficult cleaning job on threaded parts such as chuck jaws, chuck nuts, etc.

A.G.F. RECIPROCATING FURNACES FOR PRODUCTION HEAT TREATING

The following are but a few of their many desirable features:

VERSATILE. Each furnace can be used without modification to process work ranging from extremely small, light springs, stampings, and drop forgings, etc., up to quite large and heavy pieces.

POSITIVE ATMOSPHERE CONTROL. The full muffle type Reciprocating Furnace has been redesigned to provide a 100% atmosphere seal.

SIMPLE. There is no complicated drive mechanism or conveyor belt maintenance problem. Only the work, advancing through the muffle by its own momentum, enters and leaves the furnace.

ECONOMICAL. Increased production per man-hour, long alloy life, and minimized maintenance produce a lower heat treating cost per unit of work treated.

VISIT A.G.F. AT THE METALS SHOW

(American Gas Association Exhibit)

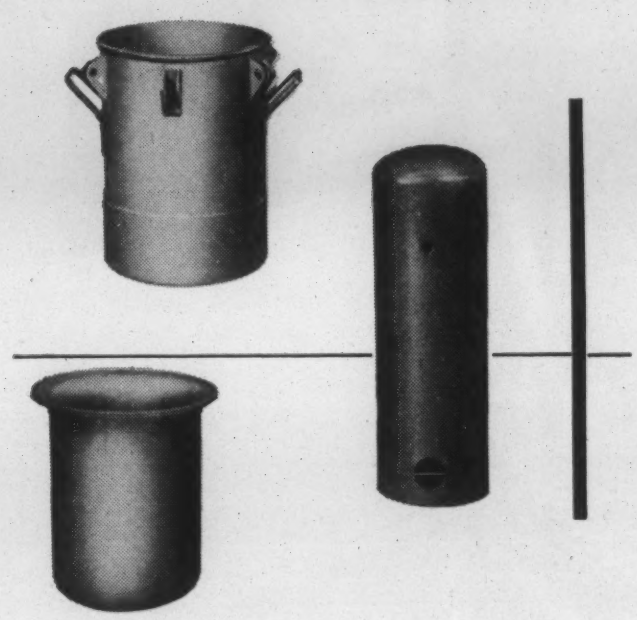
AMERICAN GAS FURNACE CO.

142 SPRING STREET · ELIZABETH, N. J.

Prest-O-Lite
Trade-Mark

Cold-Drawn SHAPES and SHELLS

made to your specifications by *Linde*



Leaders of the Field for Over 35 Years

PREST-O-LITE cold-drawn shapes and shells can be quickly and economically produced to your most rigid specifications—from 1½ to 23 inches in diameter and up to 50 inches in depth. Our greatly expanded, well-equipped plant has every modern manufacturing facility and is manned by a thoroughly experienced, highly specialized staff—prime requisites of a quality product.

LINDE engineers will gladly help you solve your production and design problems involving cold-drawn shells, cups, containers, receivers, pressure vessels, formed parts, or other shapes.

The term "Prest-O-Lite" is a trade-mark of The Linde Air Products Company.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Principal Cities

In Canada: DOMINION OXYGEN COMPANY, Limited, Toronto

The Linde Air Products Company
30 East 42nd Street
New York 17, N. Y.

Please send literature and full information about cold-drawn shapes and shells.

NAME _____

COMPANY _____

ADDRESS _____

New Materials and Equipment

die setups in the press during down time.

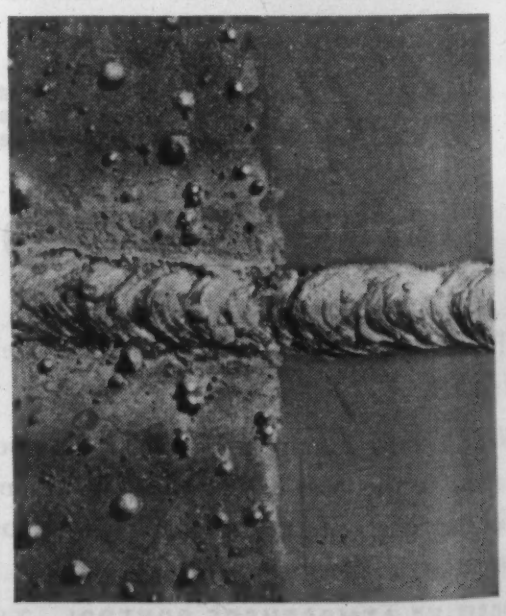
The new model augments the regular line of 4-ton Benchmasters and performs all conventional operations, such as punching, shearing, staking, rivetting, forming, coining, etc. It is rated at somewhat more than 1-ton capacity under continuous, heavy duty operation.

The Midget has a standard maximum stroke of ¾ in. with a ¾-in. hole in the ram. Approximate speed is 290 strokes per min. Overall height of the unit is 17½ in., and its weight without the motor is 65 lb. With the ram up, the distance from die space to bolster plate is 3¾ in.; throat depth is 2⅛ in. The bolster plate is removable.

Rust-Preventing Compound Also Eliminates Weld-Spatter Adhesion

G. W. Smith & Sons, Inc., 5400 Kemp Rd., Dayton 3, Ohio, has announced a new coating called Protect-o-Metal No. 8, designed to protect parts and raw stock from rusting prior to welding and between operations.

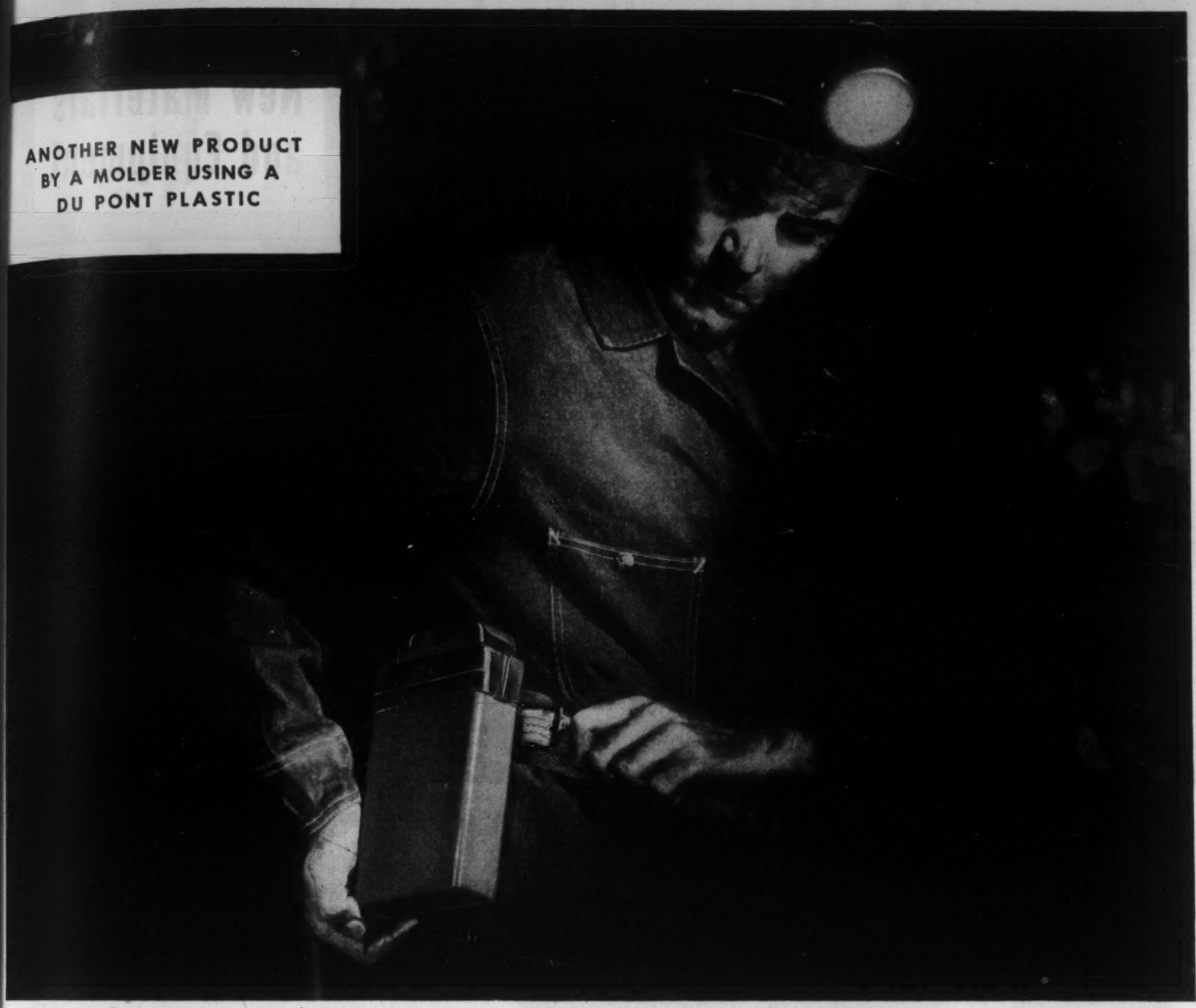
Applied with brush, spray or by dipping,



The clean part of this welded steel plate was treated with Protect-o-Metal No. 8 before welding.

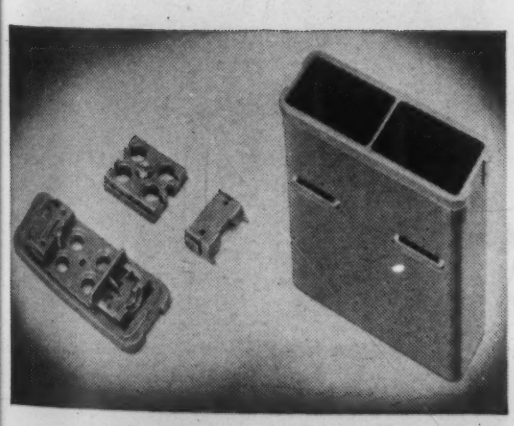
it dries in less than an hour to a thin transparent coating which is said to prevent rust up to six months in the weather and up to two years on steel stored indoors.

The coating is also intended to prevent adhesion of flash and weld spatter during welding and is claimed to save up to 85% of the time required to clean welds. The



NYLON PLASTIC CARRIES 25% MORE LIGHT FOR MINERS

New battery case of molded Du Pont nylon contributes to better vision, greater efficiency and safety



THE INTRICATE DESIGN and precision molding can readily be seen in these nylon parts of the battery case. One of nylon plastic's most practical features is its ability to be molded in various sizes, shapes or thicknesses, retaining high strength and impact resistance. In the assembly, four leak-proof valves for the cells are mounted in a single nylon plastic block. Parts fall in place with hair-line accuracy. Then the case is sealed by the magnetically locked cover.

This battery case for the new EDISON miners' cap lamp contains four cells instead of the conventional three. Yet there's no appreciable increase in size or weight in the battery case over the former 3-cell models. The increased voltage and wattage of the battery permits the use of a bulb that lasts longer and throws off a stronger beam of light.

Nylon was the choice of Thomas A. Edison, Incorporated, the designers, because it serves both as insulation between the steel cells of the battery and as an outer case which combines light weight and compactness with resistance to abrasion, impact and corrosive mine waters.

Maybe there's a spot on your production line for nylon's outstanding properties. It's easy to get the facts on nylon and all other Du Pont plastics. Write our most convenient office for literature.

E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Main Sales Offices: 350 Fifth Ave., New York 1, N. Y.; 7 S. Dearborn St., Chicago 3, Ill.; 845 E. 60th St., Los Angeles 1, Calif.

Nylon parts molded by Vulcanized Rubber and Plastics Co., Morrisville, Pa., for Thomas A. Edison, Incorporated, West Orange, N. J.

DU PONT
REG U S PAT. OFF.
Plastics
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

STAINLESS STEEL HEADS by

G. O. CARLSON, INC.

There are many advantages to buying stainless heads from G. O. Carlson, Inc. Not the least important is the fact that you place the entire responsibility in the hands of one capable organization. The same technical and production staff who produce Carlson Stainless plates to chemical industry standards, apply their skill to the production of heads to your specifications. A wide variety of head forming dies are available in both size and shape to suit your specific requirements. In addition to the dies to produce A.S.M.E. and Standard dished heads, dished and flanged heads, flared heads, flared and dished heads, we can supply special sizes spun to individual requirements.

G. O. Carlson, Inc., maintains a large stock of Stainless Steel Plates in many types and gauges to render prompt service in the production of heads.

Let G. O. Carlson, Inc. take the individual responsibility — send us your prints and specifications for quotations.

G. O. CARLSON, INC.

Stainless Steels Exclusively

200 Marshalton Road, Thorndale, Pa.

PLATES • FORGINGS • BILLETS • BARS • SHEETS (No. 1 Finish)

District Sales Offices and Warehouse Distributors in Principal Cities

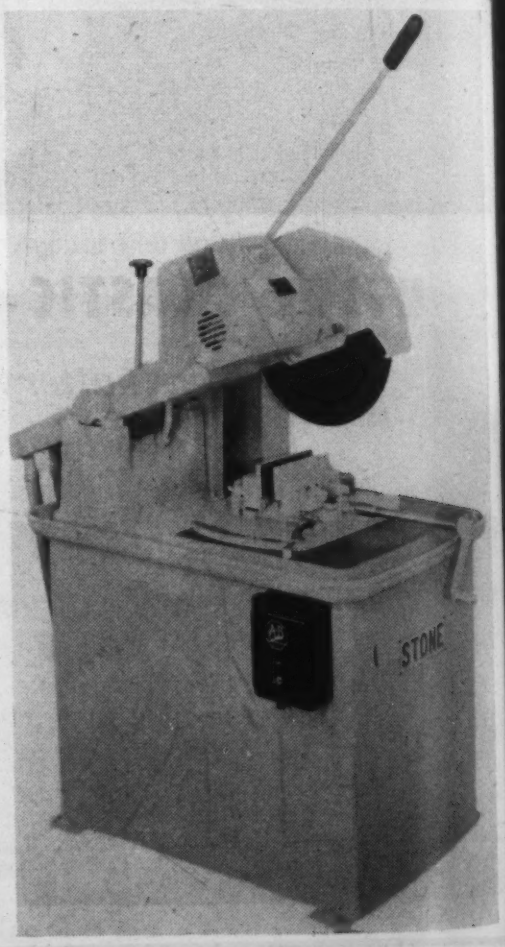
New Materials and Equipment

coating does not cause porosity and is non-corrosive; it also serves as a good base for subsequent painting.

Abrasive Metal Cut-Off Machine Features Flexibility, Low Cost

A low-cost abrasive metal cut-off machine having a capacity of 3-in. solids and 4-in. pipe in both ferrous and nonferrous materials is being produced by *Stone Machinery Co., Inc.*, 353 Fayette St., Manlius, N. Y.

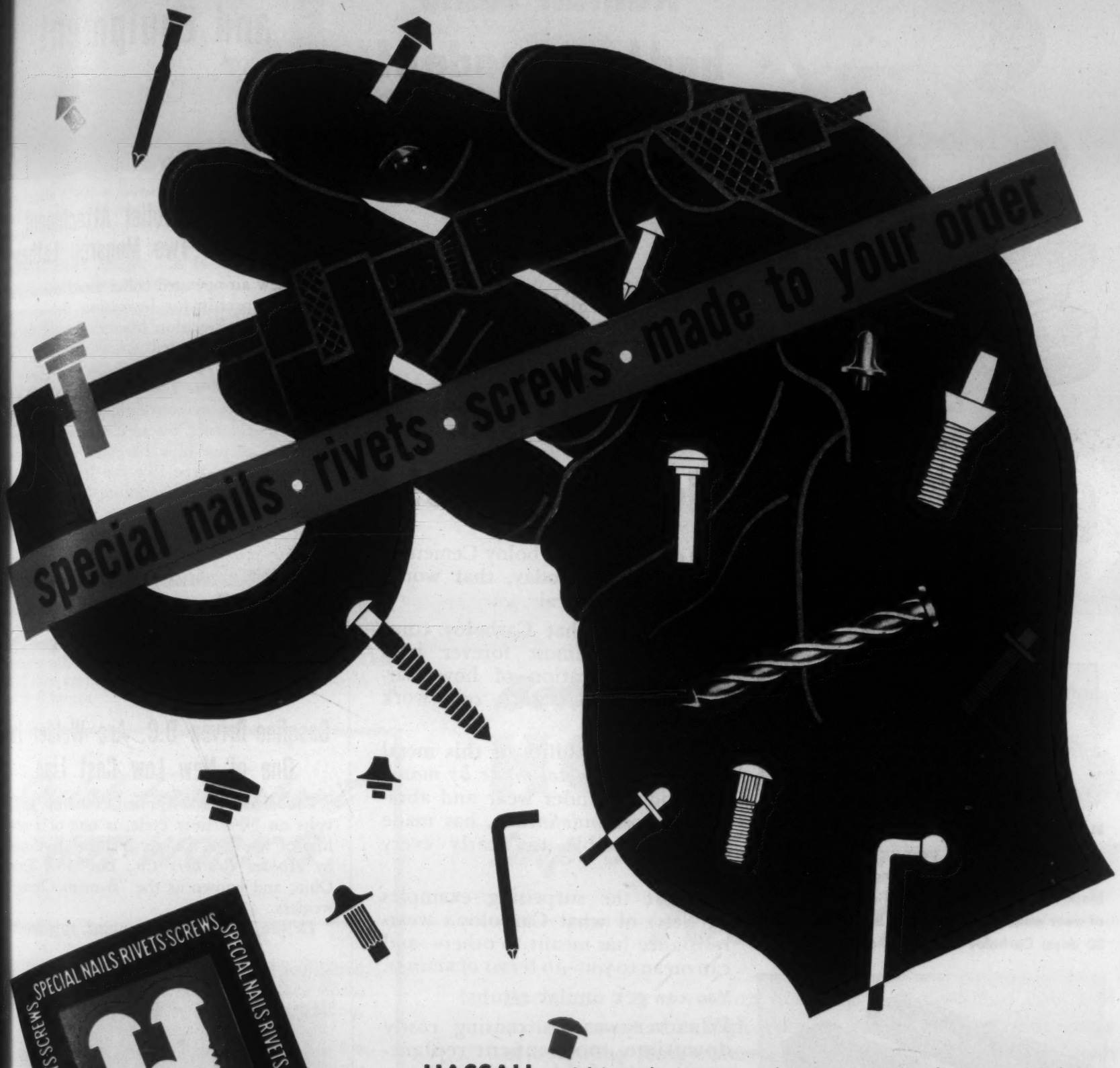
Rigid construction and positive holding are said to increase wheel life by making possible straight cuts to close tolerances with a minimum of burr. The extremely high cutting speeds used not only reduce the possibility of burr in the metal but also eliminate the necessity for wet cutting in many materials. A fast-acting, self-centering vise mounted on a quickly adjusted swivel plate, calibrated in degrees, provides for a rapid change from straight cutting to any desired angle.



Close tolerance work is claimed for this Stone Machinery Co. cut-off machine.

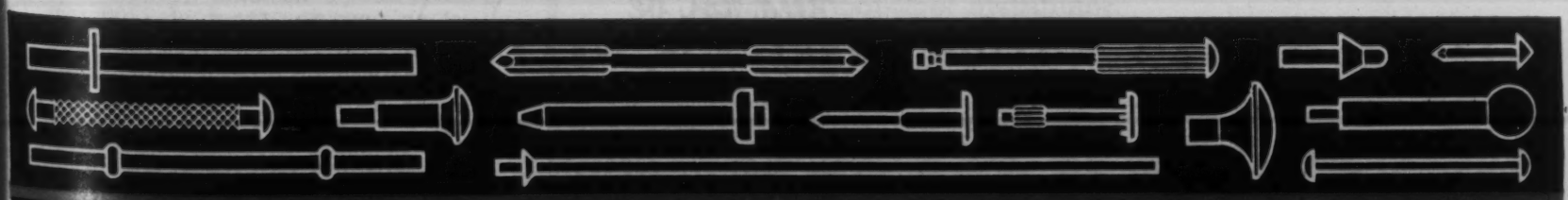
(More News on page 138)

The trained hand of Hassall offers you:



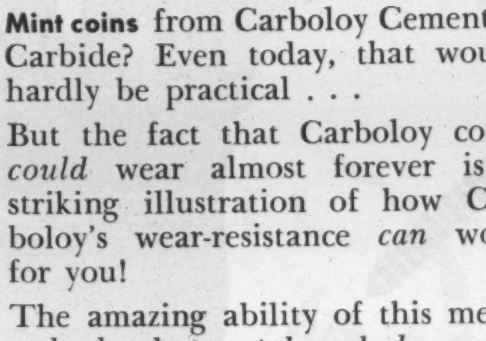
SPECIAL NAILS RIVETS SCREWS
Hassall
ESTABLISHED 1850

HASSALL cold-heading may solve your immediate special part problem... Special nails, rivets and threaded parts made in diameters from 1/32" to 3/8"—lengths up to 7"... Rivets 3/32" diameter and smaller a specialty... also small threaded blanks ...Variety of metals, finishes and secondary operations... Economy, quality and quick delivery in large or small quantities... Your inquiries answered promptly... ASK FOR FREE CATALOG ...3-color DECIMAL EQUIVALENTS WALL CHART free on request.



JOHN HASSALL, INC. • 162 CLAY STREET • BROOKLYN 22, N. Y.

If these Roman coins had been made of CARBOLOY
CEMENTED CARBIDE



they'd still look like this!

Mint coins from Carboloy Cemented Carbide? Even today, that would hardly be practical . . .

But the fact that Carboloy coins *could* wear almost forever is a striking illustration of how Carboloy's wear-resistance *can* work for you!

The amazing ability of this metal —*the hardest metal made by man*— to stand up under wear and abrasion almost *indefinitely,* has made it indispensable to nearly every industry.

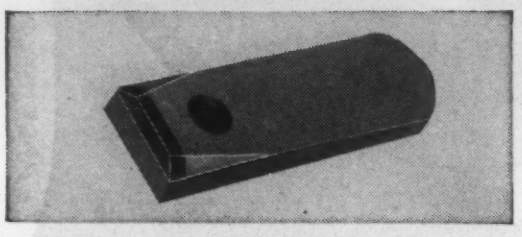
Look at the surprising examples (at left) of what Carboloy's wear-resistance has meant to others—and can mean to you—*in terms of savings.*

You can get similar results!

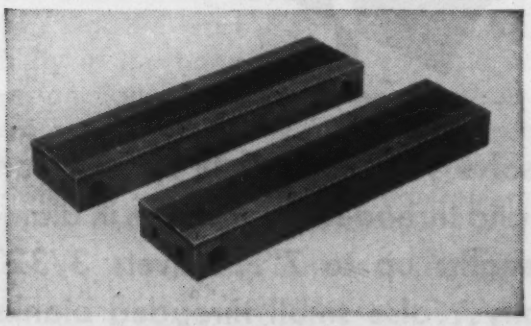
Wherever wear is causing costly downtime, too-frequent replacements, poor finishes, or too many rejects, use a wear-proof part made of Carboloy Cemented Carbide.

Don't wait. Every day, wear may be costing you more than the cost of a change-over to Carboloy! Call in a Carboloy engineer at the first sign of wear . . . *anywhere.*

CARBOLOY COMPANY, INC.
11161 E. 8 MILE AVE., DETROIT 32, MICHIGAN



BUSINESS-MACHINE MANUFACTURERS enhance the sales appeal of their products by using Carboloy parts. This tabulating-machine throat block must pass just *one card at a time:* .003" of wear makes it useless! Steel blocks lasted only 30 days; Carboloy blocks last over six months!



IN RAZOR-BLADE MANUFACTURE, quenching blocks of Carboloy Cemented Carbide (for chilling blades, to prevent distortion after heat treatment) resist excessive wear from oxide scale. By using this amazing metal, manufacturers eliminate costly part replacements.

WHEREVER THERE'S MOTION THERE need not be ~~IS~~ WEAR

WEAR PROOF with CARBOLOY® CEMENTED CARBIDE HARD METAL

New Materials and Equipment

Air-Operated Collet Attachment Available for Two Monarch Lathes

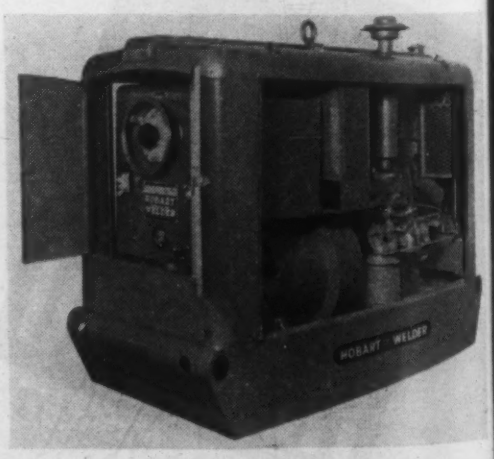
A new air-operated collet attachment, designed expressly for increasing the output of its 10-in. Precision Manufacturing Lathe and its hand-operated screw machine, the Speedi-Matic, has been developed by the *Monarch Machine Tool Co.,* Sidney, Ohio.

In contrast to conventional air-operated collet attachments, the new Monarch design permits the use of a bar feed attachment. Of the pusher type like the lever-operated collet attachment heretofore supplied for these two particular lathes, this development is designed to reduce operator fatigue on long production runs and thereby make it possible to increase the productivity of these machines.

Gasoline-Driven D.C. Arc Welder Is One of New Low Cost Line

Model ZXB-200-S, rated 200 amp. at 25 volts on 50% duty cycle, is one of a new line of low-cost d.c. arc welders developed by *Hobart Brothers Co.,* Box 489, Troy, Ohio, and known as the "Bantam Champ" welders.

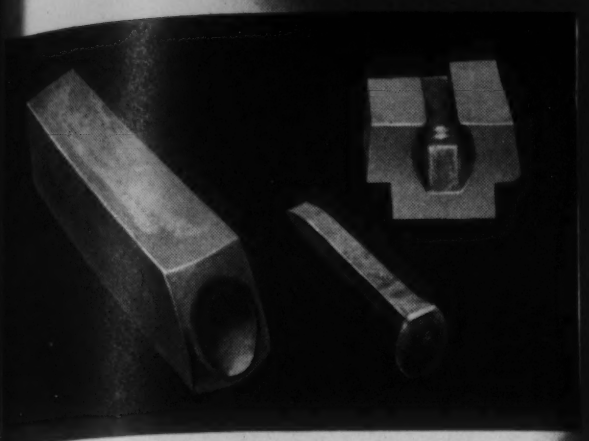
Driven by a gasoline engine, this model



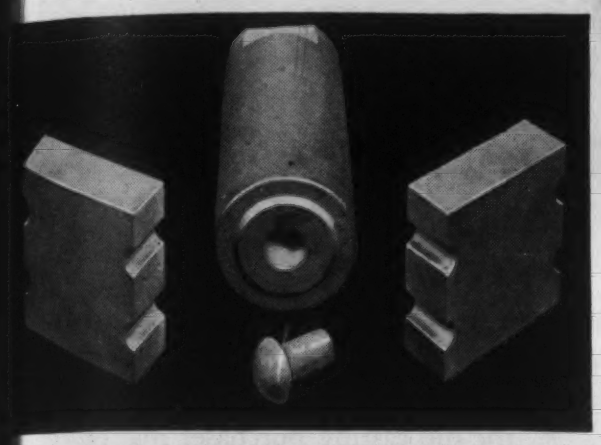
This Hobart d.c. arc welder is designed to meet a demand for low-priced equipment.

has a current range from 25 to 230 amp. at an operating speed of 2200 rpm. The machine weighs about 770 lb.

The welding controls are modified multi-range dual control, with five ranges of welding current and 100 steps of volt-ampere adjustment in each range, making available 500 combinations of open circuit voltage and welding current for selecting any desired arc characteristics.



ool costs took a nosedive when Hot-Work 8 wa ed for the hot-forging of steel spikes up to 5/8-in. uare. Spike production now averages 200,000 for es; 3,100,000 for grippers; and 1,100,000 for inters. Even longer life is obtained in the pro- ction of smaller spikes.



nger tool life resulted when Hot-Work 8 was used r these header and gripper dies in the semi-auto- atic manufacture of steel rivets. These dies out- roduce other hot-work steels previously used. One t of dies turns out 45,000 rivets of 5/8-in. to 3/4-in. e in 8 hours.

Quick Facts about HOT-WORK 8

TYPICAL ANALYSIS:	C	Cr	Mo	V
	0.60	3.60	8.50	1.75

RED-HARDNESS: High. Excellent resistance to heat-checking and surface wash. Withstands repeated drastic cooling.

WEAR-RESISTANCE: High. For maximum service life in the medium- and high-temperature ranges. Hot-Work 8 gives excellent service life in applications where the tool or die reaches temperatures as high as 1400 F. The material being worked has, of course, much higher temperatures.

SHOCK-RESISTANCE: Good. Stands up under heavy impacts.

HEAT-TREATMENT: Anneal at 1600 F, furnace-cool. Pre-heat to 1600 F prior to hardening. Harden at 2150 to 2200 F, followed by air-quench. Temper at 1120 F for best wear-resistance; at 1200 F for best shock-resistance. Rockwell C-44 to 55.

Write us for your copy of the new booklet, "Bethlehem Hot-Work Tool Steels."

Bethlehem

HOT-WORK 8

improves high-temperature TOOL LIFE

Hot-Work 8 is a veteran hot-work tool steel that cuts tool costs because of its high wear-resistance in the higher range of operating temperatures. High resistance to surface wash and heat-checking also account for its long service life on severe hot-work applications. It all adds up to longer life, fewer redressings . . . and lower costs.

Choose Hot-Work 8 when temperatures are high or variable; and when the tool or die is subject to drastic cooling during operation. Hot-Work 8 is versatile because of its excellent balance of properties for such applications as crowners, dollies, hot punches, stamps, striking dies, hot headers, hot shear blades, hot stamps, trimmers, and gripper dies. Full details are available from the nearest Bethlehem sales office or tool-steel distributor.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation

Export Distributor:
Bethlehem Steel Export Corporation

BETHLEHEM STEEL

HOT-WORK 8...one of Bethlehem's Fine Tool Steels

Improved quality control of metals at **LOWER COST**

SPERRY ULTRASONIC REFLECTOSCOPE

Reflectoscope, Type UR, Style 50E351.

Provides rapid accurate non-destructive testing of steel and other metals

Metals tested by the Reflectoscope are preferred by users who cannot afford lost machine and man hours. The expense of lost work on faulty metals and possibility of service failures are minimized when potentially harmful defects are located before fabricating or machining.

The cost per test is low because it is instantaneous. The operator touches the quartz-crystal Searching Unit to the surface and immediately "sees" through the metal. Discontinuities are revealed on the Reflectoscope screen and are located accurately. For full details write for new Bulletin 50101.

- CONTROLLED SENSITIVITY —can be adjusted to meet quality control standards.
- PORTABLE UNIT — can be set-up quickly by one man.
- TESTS PARTS "IN PLACE" —locates fatigue cracks in shafts, rolls, axles and other stressed parts. Operates on 100-130 volt, 60 cycle current.

See the **REFLECTOSCOPE**
at Booth 1920
NATIONAL METALS EXPOSITION
October 17th to 21st

SPERRY PRODUCTS, INC.
DANBURY, CONN.

SPERRY
SP-159

News Digest (continued)

creep resistance. The cables are capable of operating at temperatures higher than those possible with lead, thus permitting a reduction in copper section up to 25%.

In this country plastic sheathing was tried, during the period of acute lead shortage, with moderate success.

Die Castings Purchasers Aided by Quality Certification Plan

Details of the Certified Zinc Alloy Plan, which has been operating under the supervision of the American Die Casting Institute since April 1, have now been released to the metals industry. The plan is designed to assure the die casting purchaser that proper zinc alloys and adequate processing controls have been employed in production.

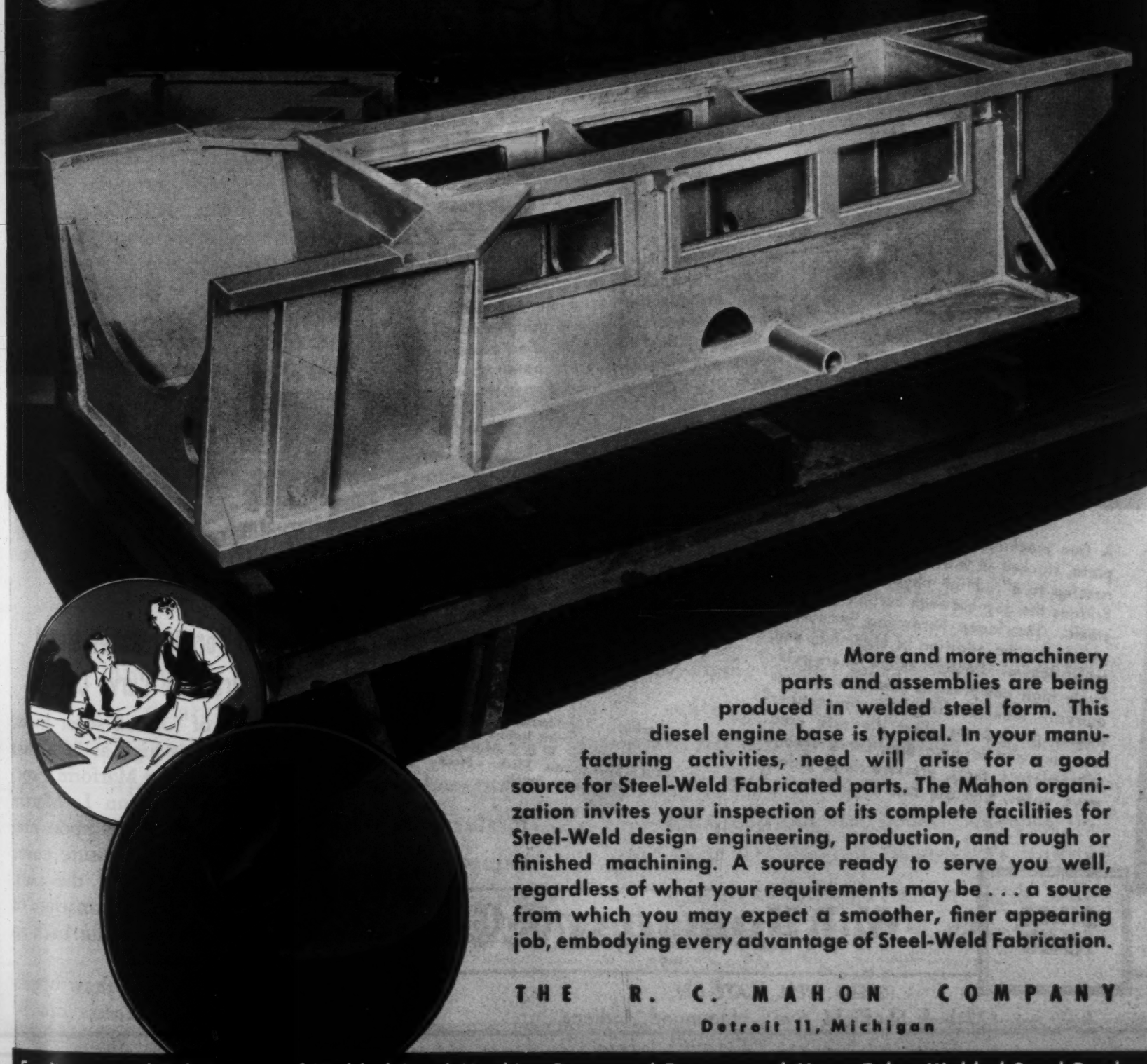
The plan calls for frequent sampling of castings from all participating die casting producers and subsequent analysis of these samples by an approved laboratory. Only producers whose castings continually meet established ASTM standards are permitted to use a special certification seal on their products.

Broad Study of Magnesium Systems Yields Promising Alloy Type

Of some 200 alloys in 40 magnesium alloy systems, magnesium-zinc-silver-manganese-calcium is the most promising combination for additional development, according to a report published by the Office of Technical Services of the U. S. Commerce Dept. Investigations were carried on by Rensselaer Polytechnic Institute for the Air Force.

The broad study also disproved certain favorable assumptions on the strength and workability of the German Giesche alloy. Another investigation showed that the addition of 5% each of the intermetallic compounds, $Cd_{21}Ni_5$, Cd_3Cu and Cd_3Sb_2,

Steel-Weld FABRICATION



More and more machinery parts and assemblies are being produced in welded steel form. This diesel engine base is typical. In your manufacturing activities, need will arise for a good source for Steel-Weld Fabricated parts. The Mahon organization invites your inspection of its complete facilities for Steel-Weld design engineering, production, and rough or finished machining. A source ready to serve you well, regardless of what your requirements may be . . . a source from which you may expect a smoother, finer appearing job, embodying every advantage of Steel-Weld Fabrication.

THE R. C. MAHON COMPANY
Detroit 11, Michigan

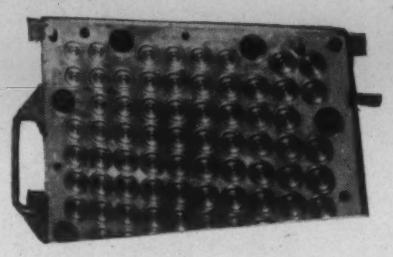
Engineers and Fabricators of Welded Steel Machine Bases and Frames, and Many Other Welded Steel Products

MAHON

THESE 3 SPEED STEELS ARE "money in your pocket"

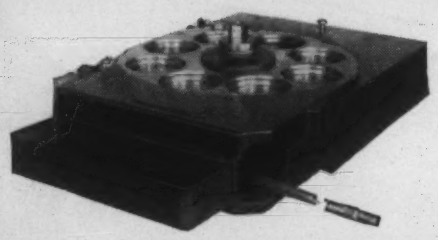
SPEED CASE

A free machining, low carbon, open hearth steel plate, stocked in thicknesses ¼" to 8". Tensile strength 58-72,000 p.s.i. At cutting speeds of 150-250 s.f.p.m. tool life averages 5 to 15 times that of other open hearth steels. It is easily carburized to achieve high surface hardness, and can be forged, cold formed, or welded, using proper techniques. Ideal for molds, dies, plates, fixtures, sprockets, etc.



80 cavity male Speed Case rubber mold. Machining costs lowered 41%.

SPEED TREAT

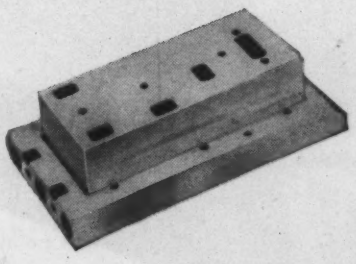


8 station ratchet dial feed, for "cupping" press, of Speed Treat.

A free machining, medium carbon, open hearth steel plate, stocked in thicknesses ¼" to 8". Tensile strength as rolled 90,000 to 105,000 p.s.i. Average cutting speeds of 135-145 s.f.p.m. produce an excellent finish, reducing polishing time and increasing tool life. It can be direct quenched - carburized and hardened, or induction or flame hardened. Can be forged and welded using proper techniques. Ideal for molds, dies, plates, rollers, gears, crane buckets, power shovel dippers, baling press housings, etc.

SPEED ALLOY

A free machining, hot rolled, alloy steel plate, stocked in widths up to 72", thickness up to 6". High physical properties. Bridges the gap between carbon and tool steels. Has deep hardening properties gained by the addition of chromium and molybdenum. Recommended where relatively high compressive strengths are required. Ideal for extra quality rubber molds, press brake dies, die sets, cold trimming and forming dies, cams, eccentrics, platens, racks, pressure rings, slides, ways, yokes, zinc die cast dies, etc.



Carburized and hardened Speed Alloy mold, with hobbed cavities, made by W & L Molding Co., Kalamazoo, Mich. Note mirror finish.

SINCE 1856

W. J. HOLLIDAY & CO. (INC.)

SPEED STEEL PLATE DIV.

137th & Sheffield Ave., Hammond, Indiana

Plants: Hammond and Indianapolis, Indiana

DISTRIBUTED BY

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Peninsular Steel Co. Detroit, Mich.
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Horace T. Potts Co. Philadelphia - Baltimore

News Digest (continued)

failed to improve the mechanical properties of magnesium and magnesium-zinc base compositions. A tendency toward increased ductility and toughness with moderate strength properties for dilute magnesium-base alloys as a result of warm-rolling procedures was noted in the report.

Use of Geiger Counter May Speed Chemical Analysis of Steel

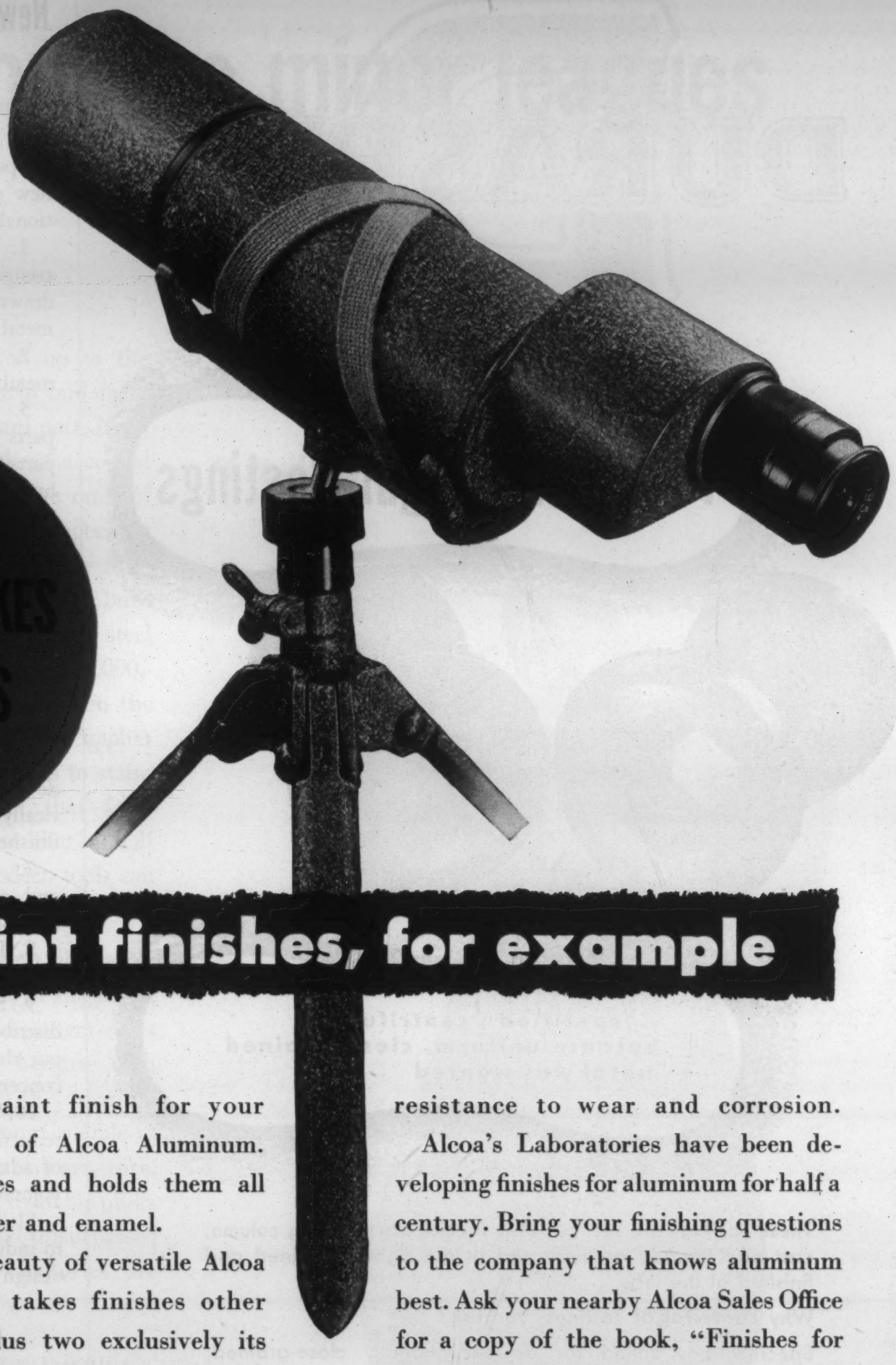
The Geiger counter is now being used for chemical analysis of steel in the Research Laboratory of the U. S. Steel Corp. of Delaware. A molybdenum target X-ray tube is used to ionize the steel sample, which then emits secondary rays characteristic of the chemical elements present. These fluorescent rays are reflected to a crystal monochromater, which is scanned by a Geiger counter connected to a recording instrument. The recorder plots the intensities corresponding to the various chemical elements.

U. S. Steel scientists expect further refinement of this method will make it faster than the direct-reading spectrograph.

Cost of Forming Sheet Metal Cut By Pressure Curve Control

Production of formed sheet metal parts at savings as high as 50% has been claimed for the Marform process, developed by Glenn L. Martin Co. The process depends upon precision control of the pressure curve for the forming cycle of the part. Close control prevents formation of wrinkles and reduces spring back to a minimum.

In addition to simple draw operations, the Marform process can be used to form and trim flanged parts and to shear, as well as form, in the same operation. Martin engineers expect the Marform process to produce savings of hundreds of thousands of dollars annually for the aircraft industry as a result of increased production rates and decreased labor and tooling costs.



ALUMINUM TAKES
ALL FINISHES

Paint finishes, for example

Choose any paint finish for your products made of Alcoa Aluminum. Aluminum takes and holds them all . . . paint, lacquer and enamel.

That's the beauty of versatile Alcoa Aluminum. It takes finishes other metals take, plus two exclusively its own. Only aluminum takes the patented Alumilite and Alrok finishes that seal color *in* the metal surface and add resistance to wear and corrosion.

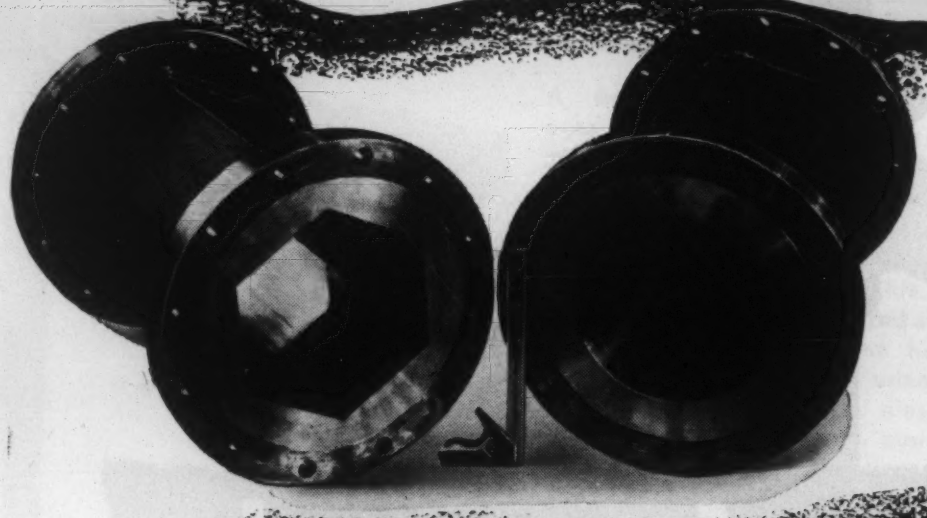
Alcoa's Laboratories have been developing finishes for aluminum for half a century. Bring your finishing questions to the company that knows aluminum best. Ask your nearby Alcoa Sales Office for a copy of the book, "Finishes for Alcoa Aluminum". Or write ALUMINUM COMPANY OF AMERICA, 662K Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM

INGOT • SHEET & PLATE • SHAPES, ROLLED & EXTRUDED • WIRE • ROD • BAR • TUBING • PIPE • SAND, DIE & PERMANENT MOLD CASTINGS • FORGINGS • IMPACT EXTRUSIONS
ELECTRICAL CONDUCTORS • SCREW MACHINE PRODUCTS • FABRICATED PRODUCTS • FASTENERS • FOIL • ALUMINUM PIGMENTS • MAGNESIUM PRODUCTS

DURASPUN

18-8 Centrifugal Castings



...specified "centrifugal" because uniform, close-grained metal was wanted

These castings are sections of a special fractionating column, cast and flanged as illustrated at the right; machined and finished at the left.

Why **centrifugal** castings, you ask?

Specifications called for an exceptionally close-grained, uniform metal structure free from blowholes of any sort on the inner face. Centrifugal castings assure this superior metal structure.

Our service to industry is two fold: centrifugal castings and static castings, produced in one of the most modern and best technically controlled foundries in the country. Why not try Duraloy for your next high alloy casting requirement?

THE DURALOY COMPANY

Office and Plant. Scottdale, Pa. • *Eastern Office*. 12 East 41st Street, New York 17, N. Y.

F. O. NELSON
1743 McCormick Building
Chicago, Illinois

Detroit
F. B. CORNELL & ASSOCIATES

METAL GOODS CORP. St. Louis • Houston • Dallas • Tulsa • New Orleans • Kansas City

News Digest (continued)

Specific advantages claimed for the new process, compared with conventional forming practice, are:

1. It will form sheet metal to compound curvatures and with deep drawn flanges without wrinkling the metal.
2. It permits deep draws in harder metals.
3. It eliminates finish forming of parts by hand as now required on parts formed with rubber in the hydro-press and on some die-formed parts.
4. Several different parts, having complicated contours but similar pressure curves, can be formed at the same time.
5. Parts can be formed of varied materials and thicknesses within a reasonable range with little or no effect on tooling.
6. Material wall thickness in a deep drawn part is maintained practically uniform from the blank to the finished formed part.
7. Surface finishes of the metal and coatings, such as some paints and plastics, are not affected.
8. It can be adapted readily to hot forming.
9. Strains in the formed parts are distributed more uniformly throughout the piece so that harmful strain concentration is avoided.
10. It makes possible such great reductions in tooling costs that it is of advantage in low as well as high volume production.
11. It offers considerable savings to industries having frequent product design changes.

Sub-Zero Laboratory to Probe Super-Conductivity Phenomenon

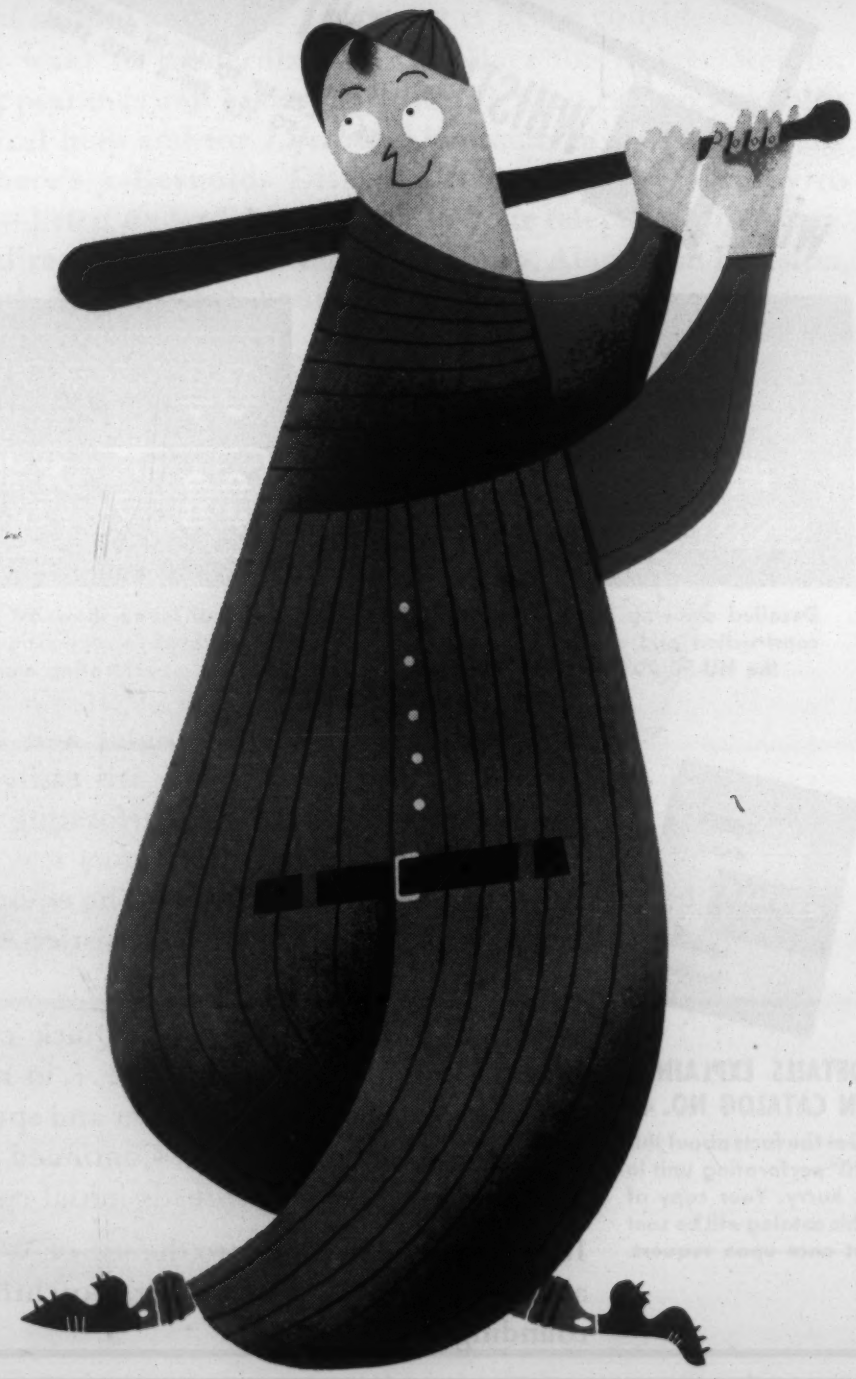
An explanation for the "superconductivity" of certain metals at sub-zero temperatures, and discovery of metals or alloys that are superconducting at higher and higher temperatures are being sought by Westinghouse scientists in their new cryogenics laboratory in Pittsburgh. So far 13 metals are known to offer no measurable resistance to flow of electric current at extremely low temperatures of the order of -450 F.

up from the minor leagues

comes stainless sheet and strip

Stainless steel has now moved up to the major leagues. Advances in strip mill techniques have played an important part. Now, CRUCIBLE, using the best of these accepted modern techniques, plus exclusive ones of its own . . . is producing stainless by specialty steel production methods at the busy Midland Works. In the *first* mill *specifically* built for the production of stainless, top steel specialists are putting to good use $18,000,000 of new tools and buildings. When the leader in the specialty steel field applies specialty steel production methods to stainless, you can rightly expect that from CRUCIBLE you'll get the best that a half century of experience and modern tools can provide.

The new mill will produce stainless in widths of ½″ to 50″ inclusive, in all gauges, grades and finishes. This is important news to users of stainless steels, because with Trent Tube Company joining the organization, you can get stainless from Crucible in every form: sheets, strip, plates, bars, wire, forgings, castings and tubing. Crucible offers comprehensive data sheets and unsurpassed metallurgical service. Your inquiries are welcome.

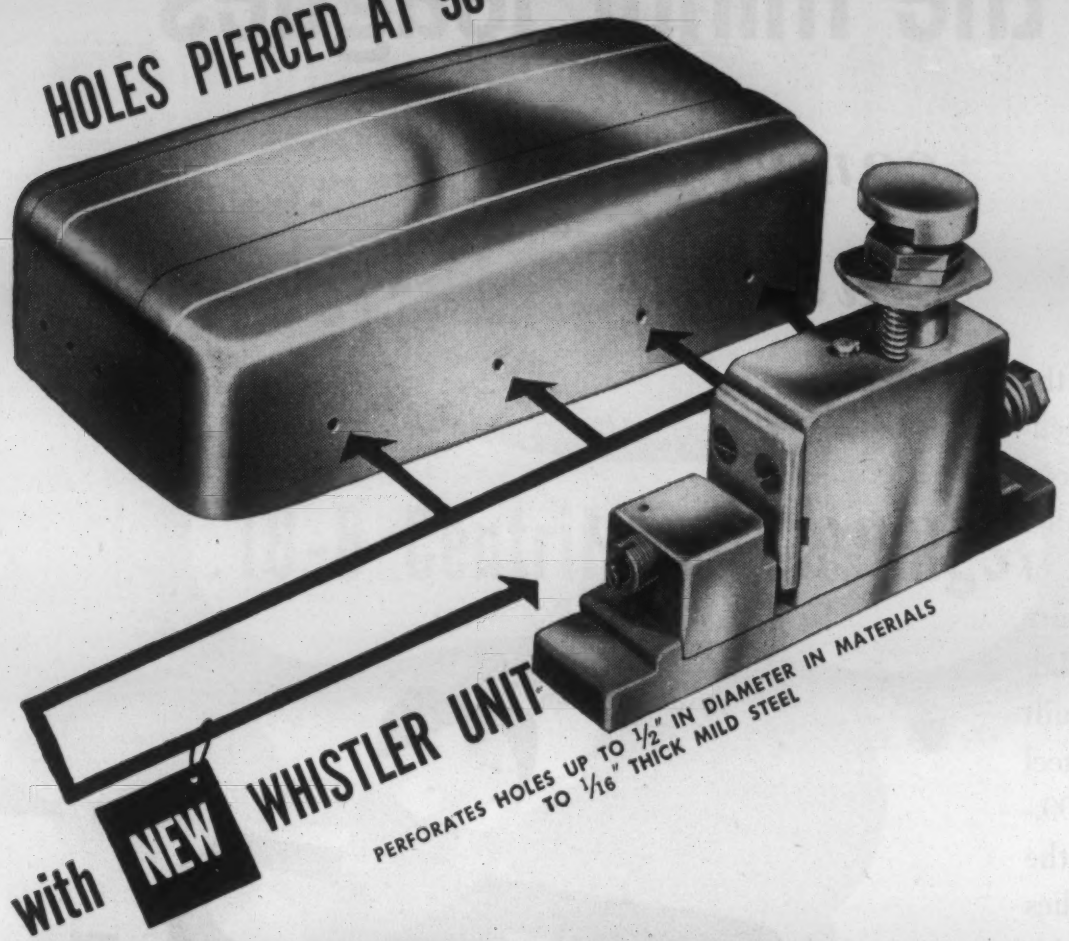


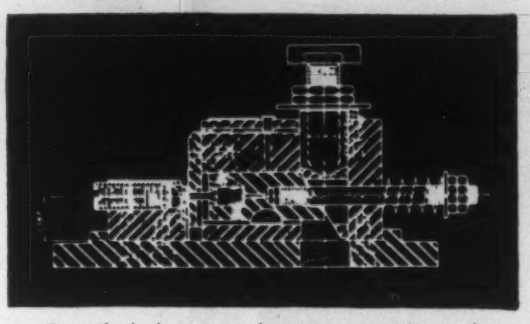
CRUCIBLE STEEL COMPANY OF AMERICA
405 Lexington Ave., New York 17, N. Y.
Branches, Warehouses and Distributors in Principal Cities

CRUCIBLE first name in special purpose steels

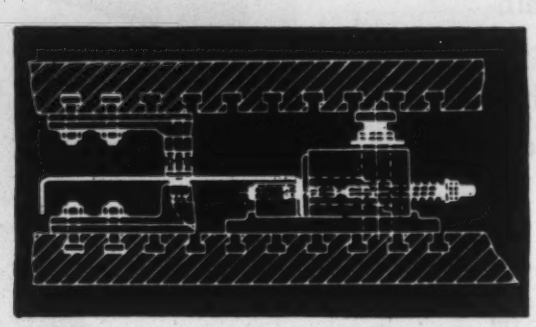
hot and cold rolled **STAINLESS SHEET AND STRIP**

STAINLESS • HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE • STEELS

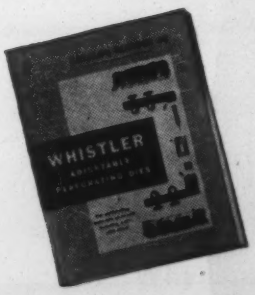

HOLES PIERCED AT 90° ANGLE...
with NEW WHISTLER UNIT
PERFORATES HOLES UP TO ½" IN DIAMETER IN MATERIALS TO 1/16" THICK MILD STEEL



Detailed drawing showing simplicity of construction and all operating parts of the HU-50 90° Perforating Unit.



Typical set-up shows 90° perforating unit operated in conjunction with standard perforating equipment.



DETAILS EXPLAINED IN CATALOG NO. 48

Get the facts about this 90° perforating unit in a hurry. Your copy of this catalog will be sent at once upon request.

● Extruded shapes, ells, angles and other molded, shaped or fabricated pieces are easily pierced from the side at 90° with HU-50 Perforating Units. Quickly set up and adjustable, these units may be used separately or with standard perforating equipment. The advantages provided by other Whistler Adjustable Dies are retained.

Absolute accuracy is assured. Quick change-over of hole arrangements can be made... in many cases, on the press. Production economies and speeded up operating schedules are effected. Continued re-use of units in different groupings spreads initial cost.

It makes sense to look into the use of Whistler Adjustable Dies for all perforating, notching, slitting or rounding operations.

S. B. WHISTLER & SONS, INC.

756 MILITARY ROAD • BUFFALO 17, NEW YORK

News Digest (continued)

According to Dr. Aaron Wexler, in charge of low-temperature studies at Westinghouse Research Laboratories, the most important of these metals are columbium, tantalum, vanadium and their alloys, as they become resistance-free at relatively "high" temperatures, thus reducing the refrigeration problem. Pure columbium, for example, becomes super-conductive at 16 deg. above absolute zero (-459.7 F), its nitride at 29 deg. above absolute zero.

Proper harnessing of the superconductivity phenomenon might lead to cheaper and more efficient distribution of electricity.

Conditions Affecting Fatigue Limit of Plated Steel Studied

Although chromium plating reduces the fatigue limits of steels, a recent study by Hugh L. Logan of the National Bureau of Standards shows that the effect is less pronounced under some conditions than others. Sponsored by the Bureau of Aeronautics of the Navy Dept., the investigation was concerned with SAE X4130 and SAE 6130 steels used in aircraft.

In general, the reduction in fatigue limit increased with increased hardness of the steels. For steel of a given hardness, the fatigue limit decreased with increased temperature of the plating bath. Plate thickness had little effect on the fatigue limit of specimens plated at 131 F and a current density of 350 amp. per sq. ft., but no generalizations can be made regarding the effect of this factor at other temperatures and current densities.

Fatigue limits of specimens plated and subsequently ground to remove part of the plate were found equal to or greater than those of specimens originally plated to the same thickness as the ground specimens and tested as plated. Other tests showed that interruptions of the plating process had no effect provided proper precautions were observed.

REYNOLDS ALUMINUM
GOOD FOR BABIES GOOD FOR BUSINESS

Designing the Pramquin—a suitcase size baby-tender that opens by stages into basinet, car seat carrier, carriage and play pen—put every practical material to the test. Five different metals were considered and Reynolds *Lifetime* Aluminum was selected for its economy, light weight, corrosion resistance and freedom from red-rust. The unit in steel, weighing nearly 45 pounds, was too heavy—50% heavier than aluminum. Magnesium was ruled out because of high costs and difficult fabrication. Other metals were too heavy, too costly or too slow in production.

For fast production, the aluminum is assembled almost entirely by spot welding with some gas welding. And although designed for a 65-pound child, it has supported live loads three times greater without failure. The present finish is two-toned baked enamel but natural and color anodizing is being considered.

Do you want to modernize your product for lighter weight, smarter appearance and easier fabrication? Then call on Reynolds for technical help and for *Lifetime* Aluminum in one of its many forms. There's a Reynolds Distributor or Sales Office ready to serve you—listed under "Aluminum" in your telephone directory. Or write direct to Reynolds Metals Company, Aluminum Division, 2560 South Third Street, Louisville 1, Kentucky.

ALUMINUM STRUCTURAL DESIGN BOOK—*120 pages of factual data. It's yours without cost when requested on your company letterhead.*

IF YOU SEE RUST YOU KNOW IT'S NOT ALUMINUM

REYNOLDS METALS

REYNOLDS *Lifetime* ALUMINUM

CONSIDER ALUMINUM . . . CONSULT REYNOLDS . . . THE COMPLETE ALUMINUM SERVICE

. . . to quote or counsel on molded plastics

Your Watertown man is an expert in plastics, backed by 34 years of experience with every type of plastic, every type of molding method. Calling him in to quote or consult on any part, product *or idea* involving molded plastic won't cost you a cent . . . will give you the benefit of our design and engineering skill, as well as our laboratory — second to none in the industry — in developing and producing the job to your satisfaction and your customers'.

If you have a custom molded plastics job on the fire, phone your nearest Watertown man today . . . or phone or write us directly. Here are the Watertown men . . .

NEW YORK — H. A. Rankow, 175 Fifth Ave.
CHICAGO — National Insulations Company, 2808 W. Lake St.
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J. P. Bonnamy J. R. Kallaher
DETROIT — J. P. Greener from Chicago
CLEVELAND — Carl F. Linn, 866 Hanna Bldg.
MILWAUKEE — Roger L. Miller, 729 N. Broadway
SEATTLE — John W. Witherow, National Vulcanized Fibre Co. 1927 First Ave., South
SAN FRANCISCO — G. W. Harmssen, National Vulcanized Fibre Co. 273 Seventh Ave.
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THE WATERTOWN MANUFACTURING CO.
600 ECHO LAKE RD., WATERTOWN, CONN.

Real Economy in Production — by PRECISION METALSMITHS Method of "Lost Wax" Precision Investment Metalcasting

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See our wax patterns actually made at the METAL SHOW Cleveland Oct. 17-21

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BOOTH No. 2515

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You are also cordially invited to visit our plant to observe our entire process.

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PRECISION METALSMITHS, Inc.
Leaders in Precision Investment Metalcasting
6511 CEDAR AVENUE EXpress 6555 CLEVELAND 3, OHIO

News Digest (continued)

The effect on fatigue limit of heating chromium-plated steel to expel hydrogen from the deposit was also investigated. Results showed that fatigue limits of quenched and tempered plated specimens decrease to minimum values for heating temperatures between 210 and 570 F, and thereafter increase with higher heating temperatures.

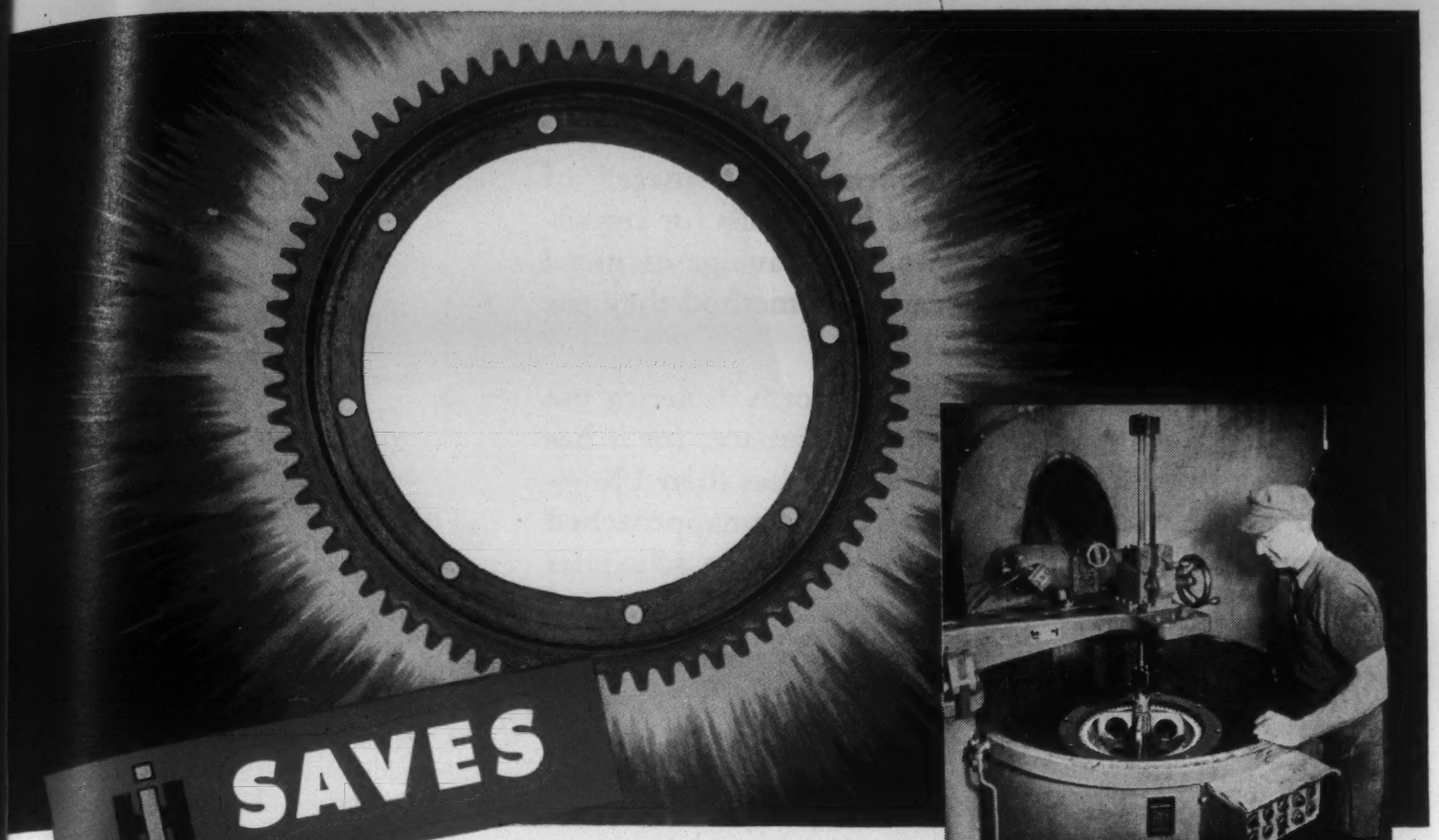
Further tests seemed to indicate that the decreased fatigue limit obtained by heating plated specimens at about 400 F was due to increased tensile stresses induced in the chromium plate. For higher heating temperatures it is believed that the contractive forces in the chromium produce enough tensile stresses to cause plastic flow or rupture of the plate, thus relieving the residual tensile stresses in it and raising the fatigue limit.

Residual stresses are believed to be a primary cause of the adverse effect of chromium plating on fatigue limits of steel. No simple relationship between the fatigue limit and amount of hydrogen remaining in the plate after baking was found, and further evidence indicated that cracks in the plate were not the principal cause of reduced fatigue limits.

Lighter Automobiles to Result from Gas Turbines, ASME Told

Automotive gas turbines, now on the way, will result in lighter automobiles, according to Prof. Frank L. Schwartz of the mechanical engineering department of the University of Michigan. Prof. Schwartz told the fall meeting of the American Society of Mechanical Engineers in Erie, Pa., that gas turbines can effect a 50% saving in weight of the automotive engine. In addition, each pound of engine weight saved results in a saving of one pound of chassis weight.

Prof. Schwartz pointed out that many problems must be solved before the gas turbine becomes a practical machine which can compete with the reciprocating engine for vehicle propulsion. Further development work in metallurgy is one of the prerequisites.



This TOCCO gear machine is powered by a 150 K.W., 10,000 cycle motor-generator set. Photo—courtesy of International Harvester Company.

$82,507 Per Year with TOCCO* Induction Hardening

GEARS, shafts, pins, wheels, tubes and bars—almost any size or shape of part—or any metal, too—is adaptable to TOCCO hardening, brazing, annealing or heating for forging.

PRODUCTION UP—Engineers at the Milwaukee Works of International Harvester Company have adopted TOCCO for hardening final drive gears for famous International Harvester farm tractors. TOCCO increases production on the gear shown here from 14 to 35 per hour, 250% faster than conventional heating method, reduces job from a 3 shift to 2 shift operation, even with increased production schedule. Heating time is 35 seconds; oil quench, 60 seconds.

COSTS DOWN—TOCCO cuts cost—saves $82,507 per year on application shown above. TOCCO makes possible use of C-1050 A.R.R. steel instead of expensive A-8645-H alloy steel previously required. TOCCO also eliminates shot-blast, formerly needed to remove scale, and extra machining operations that used to be necessary to compensate for distortion.

Gear shown is 18½″ O.D., width of face is 2″, weight 34 pounds, 73 teeth. Hardness obtained is 55-66 R.C., using 140 K.W. of 10,000 cycle power.

●

Our Engineers can probably find applications in your plant where TOCCO can increase output and reduce unit costs.

THE OHIO CRANKSHAFT COMPANY

TOCCO

*Trade Mark Reg. U. S. Pat. Off.

Mail Coupon Today

NEW FREE BULLETIN

THE OHIO CRANKSHAFT CO.
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Please send copy of "Typical Results of TOCCO Induction Heating for Forming and Forging".

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HOW THE WROUGHT BRASS INDUSTRY CONSERVES METAL

No industry melting *commensurate tonnage** of vital metal can quite match the brass mills for conservation and low melting losses. The savings of metal total millions of pounds; clearly the method they use is worth noting:

Virtually all the brass mills in North America use the Ajax-Wyatt induction melting furnace, for it has the lowest metal losses in the field — less than 1% — with superior temperature control and unapproached economy of operation on high production schedules such as we have today.

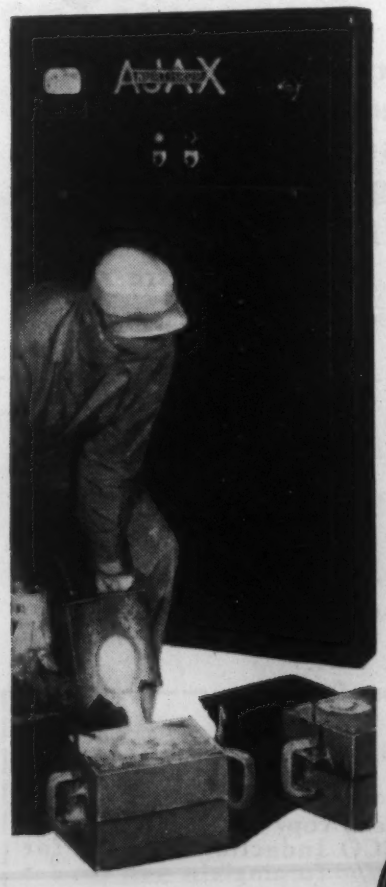
The accepted melting tool in brass rolling mills throughout the world.

* *Upwards of 5 billion pounds annually.*

AJAX ELECTRIC FURNACE CORP.
1108 Frankford Avenue • Philadelphia 25, Pa.

THE AJAX WYATT INDUCTION MELTING FURNACE

ASSOCIATE COMPANIES:
AJAX METAL COMPANY, *Non-Ferrous Ingot Metals and Alloys for Foundry Use*
AJAX ELECTROTHERMIC CORPORATION, *Ajax-Northrup High Frequency Induction Furnaces*
AJAX ELECTRIC COMPANY, INC., *The Ajax-Hultgren Electric Salt Bath Furnace*
AJAX ENGINEERING CORPORATION, *Ajax-Tama-Wyatt Aluminum Melting Induction Furnaces*



7 points for better melting

OF FERROUS, NON-FERROUS OR PRECIOUS METALS

WITH AJAX - NORTHRUP FURNACES

- Push-button control. The new Ajax-Northrup converter is self-tuning, does not require any adjustments while melting
- Negligible maintenance, limited to annual inspection of two electrodes
- Efficient, low-cost melting, with trouble-free performance
- Extended crucible life
- Reproduces the same analysis melt after melt—even with tough-to-handle alloys
- Easy, quick changeover from one alloy to another makes it the ideal tool for small foundries, precision casting, and research
- High Speed—20 Kw. converter melts 30 lbs. of brass in 20 minutes, or 17 lbs. of steel in 29 minutes. Built also in 3, 6 and 40 kw. sizes. Generator operated units to 8 tons

AJAX ELECTROTHERMIC CORPORATION
AJAX PARK, TRENTON 5, N. J.

Associate Companies
THE AJAX METAL COMPANY • AJAX ELECTRIC FURNACE CORPORATION
AJAX ELECTRIC COMPANY, INC. • AJAX ENGINEERING CORPORATION

AJAX NORTHRUP
HEATING & MELTING

SINCE 1916

1155

News Digest (continued)

Half-Hour Color Film Available on Malleable Iron Industry

A half-hour sound and color fil which tells the story of the Americ malleable iron industry has been i troduced by the Malleable Fou ders' Society. Entitled "This Movi World," the picture shows found operation and demonstrates the pro erties and applications of malleab iron castings.

The film will be shown to eng neering and technical societies, eng neering students, customers of th industry, business groups, and othe interested. Inquiries from groups in terested in seeing the film should b addressed to the Society, 1800 Unio Commerce Building, Cleveland 1 Ohio.

Fungicide Developed by Army Hits Tropical Deterioration

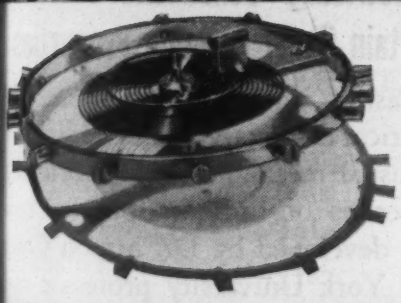
Preliminary test results on a new compound developed by the Army Engineer Corps have led scientists t believe that the Army's tropical fun gus problems may be a thing of th past. The compound has been so suc cessful in preventing deterioration o wood and fabric under tropical con ditions that it is expected to have lasting effects upon the paint and pro tective coating industry.

Known as "Copper 8," the com pound results from the reaction o 8-hydroxyquinoline with copper ace tate. It is basically an insoluble pow der which is effective as a fungicide when mixed into paint or impreg nated into fabric.

An Apology

Through a typographical error, the name of the International Nickel Co. was inadvertently omitted from the published story on the corrosion testing station at Kure Beach, N. C., which appeared on page 54 of the September issue of MATERIALS & METHODS. This was unfortunate, inasmuch as this company is chiefly responsible for the operation of the station. We apologize.

NACA Photo



Hair Springs and Jet Engines

...IMPROVED BY HIGH VACUUM

AT several famous watch factories hair springs and main springs emerge from the vacuum annealing furnace with a bright finish. Thus, cleaning operations that are costly to the manufacturer and tend to weaken the springs are eliminated.

Jet engines impose terrific heats and stresses which quickly would melt or tear apart ordinary metals. The high vacuum furnace with its freedom from oxygen and other air gases is the invaluable tool of the metallurgist to produce the metals which help make possible the harnessing of jet power.

Uses for high vacuum seem unlimited. New high vacuum techniques are constantly finding their way from the laboratory into science and industry.

Lenses, insulating paper, plastic forms, metal castings are beautifully, uniformly, and inexpensively coated by vaporizing gold, silver, chromium, and other metals in high vacuum chambers.

Manufacturers of refrigerators produce more dependable products by employing high vacuum. Electronic tubes last longer the higher the vacuum achieved in them.

It may pay you to look into high vacuum techniques. The experience of DPI research men and engineers and the DPI line of high vacuum equipment are available to all industries. We invite inquiry.

SEE DPI'S EXHIBIT
OF
LATEST EQUIPMENT FOR
HIGH VACUUM IN METALLURGY
Space 1907— 31st Annual
National Metal Exposition & Congress
Cleveland • Oct. 17th - 21st

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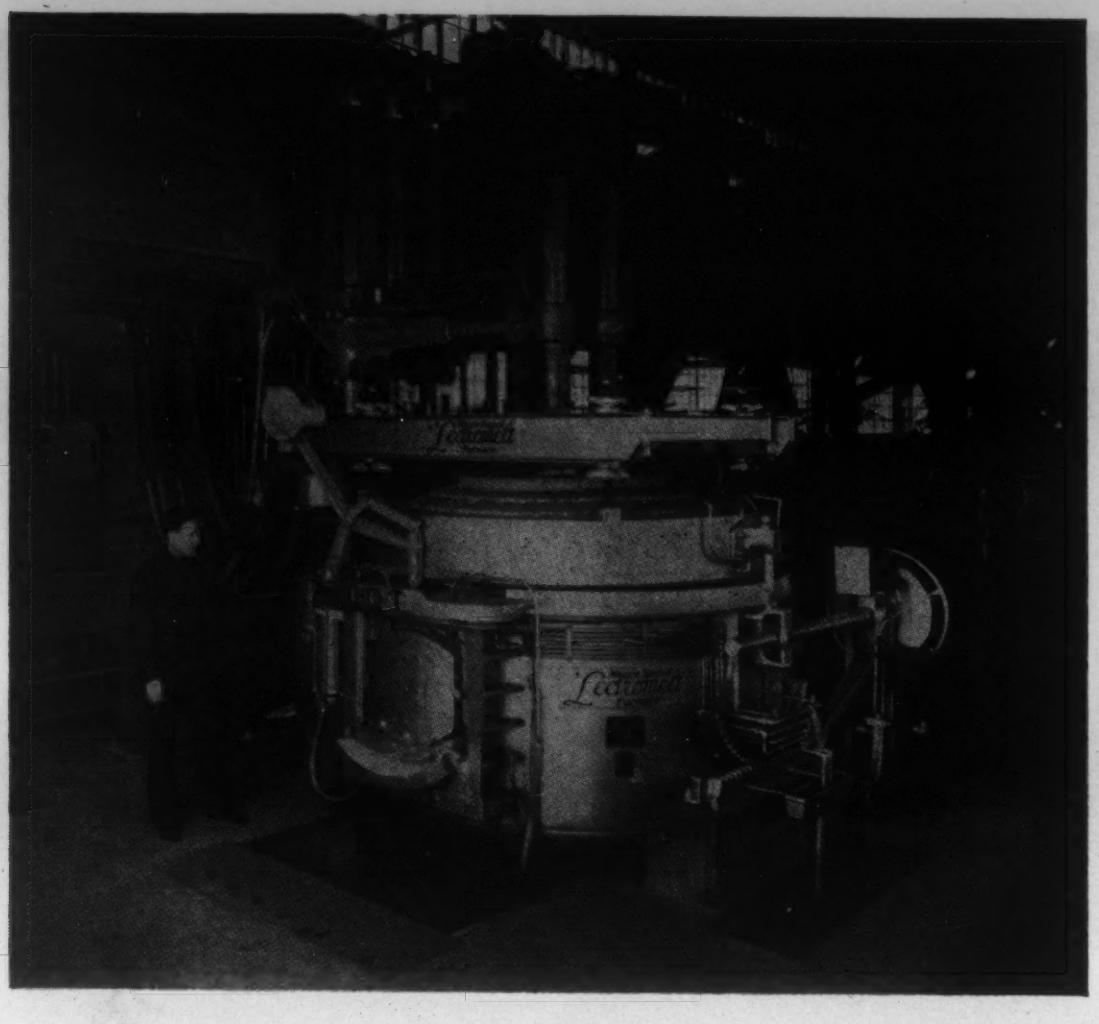
Distillers of Oil-Soluble Vitamins and Other Concentrates for Science and Industry; Manufacturers of High-Vacuum Equipment.



Ideal for Melting the New Nodular Ductile Irons

Lectromelt Furnaces, like the size CQT pictured above, provide the close control of analysis and temperature required for successful utilization of the new nodular ductile irons. These furnaces readily reduce the sulphur and phosphorous content to the low limits needed to obtain the highest physical properties.

* * * *

Lectromelt Forehearth Furnaces are being used in increasing numbers for control and adjustment of the analysis and temperature of metal melted in other equipment. They are especially designed for operation in conjunction with existing cupolas or air furnaces.

Write today for detailed information of Lectromelt's complete range of Forehearth and regular melting furnaces.

PITTSBURGH LECTROMELT FURNACE CORP.
PITTSBURGH 30, PA.

MOORE RAPID Lectromelt FURNACES

manufactured in: CANADA, Lectromelt Furnaces of Canada, Ltd., Toronto 2; ENGLAND, Birlec, Ltd., Birmingham; SWEDEN, Birlec Elektkougnar A/B, Stockholm; AUSTRALIA, Birlec Ltd., Sydney; FRANCE, Stein et Roubaix, Paris; BELGIUM, S. A. Belge Stein et Roubaix, Bressoux-Liege; SPAIN, General Electrica Espanola, Bilbao; ITALY, Forni Stein, Genoa.

News Digest (continued)

Purdue University Sponsors Metals Casting Conference

The second annual Metals Casting Conference is to be held November 3 and 4 at Lafayette, Ind. The conference is being sponsored by the Department of General Engineering, School of Chemical & Metallurgical Engineering, Purdue University. The American Foundrymen's Society and its local chapters will cooperate with the University.

On the technical side of the program, the highlight will be a paper on "Nodular Gray Iron," presented by C. O. Burgess, Technical Director of the Gray Iron Founders' Society. Other technical sessions will be devoted to metal flow in molds, control and foundry sands.

Information on the conference can be obtained by writing M. M. McClure, 209 Service and Stores Building, Purdue University, Lafayette, Ind.

Electrically Conductive Plastics Retain Usual Forming Properties

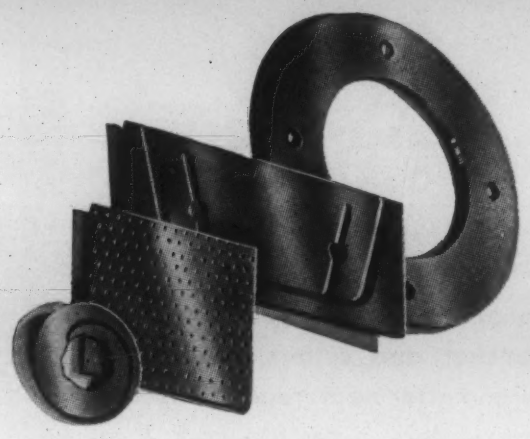
Plastics which have appreciable electrical conductivities in addition to the usual mechanical and fabrication properties of ordinary plastics have been developed by Dr. Myron Coler, New York University professor representing Markite Co., and the Naval Ordnance Laboratory, Silver Spring, Md. Thermosetting, thermoplastic and elastomeric variants of the materials, trade-named Markites, have been produced.

The new materials are expected to be of interest for applications requiring unusual intermediate conductivity values, low density, solderability, special chemical resistance, ability to take a direct electroplate, and ability to form integral leak proof bonds with certain ordinary insulator plastics.

In general, the Markites are not intended as replacements for ordinary conductors but rather as supplementary materials to be used wherever their mechanical and fabrication properties are advantageous.

Sheet Metal Bearings-2

Pre-Cast Bronze-on-Steel



WHILE this is a comparatively new type of bearing material, developed and patented by Johnson Bronze, millions of bearings and parts now in constant use provide definite proof of its excellent qualities.

Pre-Cast Bearing BRONZE-ON-STEEL is essentially a thin wall, laminated type of bearing that combines the bearing qualities of a high grade bronze alloy with the strength of steel. We start with a mixture of copper, tin and lead which is universally accepted as the best general purpose bearing bronze available. It combines, in the correct proportion, all the necessary elements to insure the utmost in bearing performance.

By casting this alloy in solid bronze bars we unite the metals chemically and form a definite copper-tin eutectic—with the lead trapped in the interstices. Thus the grain structure of the alloy—and the resulting bearings—is definitely established. Next, we reduce the bronze bar to a fine powder, about the same consistency as talcum. This powdered bronze is then treated in a hydrogen furnace to remove all oxides and then firmly bonded to copper coated strip steel. The process of manufacturing bearings from BRONZE-ON-STEEL, in strip form, is the same as for any other type of sheet metal bearing, being essentially a stamping and forming operation.

Bearings are made from this material in the same manner as bronze sheet metal bushings. The range of wall thickness is between .031" to .110". Lengths of bearings cannot exceed 4½". The smallest I.D. which can be formed is ⅜". Steel thickness for .052" wall bushings is .036"; for .070" wall it is .050" thick.

BRONZE-ON-STEEL is assembled by the same methods ordinarily used for bronze metal. It can be burnished with ordinary tools. It is also possible to bore and ream this material, but special carbide tipped tools are necessary. Diamond boring is sometimes recommended as a finishing operation.

Chemical and Physical Properties of Bronze-on-Steel

CHEMICAL ANALYSIS	Plain Bronze	Graphited Bronze
Copper	Balance	Balance
Tin	8-11	8-11
Lead	8-11	8-11
Graphite	none	1.0 max.

PHYSICAL PROPERTIES

	(1) Rockwell Hardness E Scale	(2) Wear Rate	(3) Coefficient of Friction	(4) Resistance to Pounding	(5) Resistance to Pounding
Plain Bronze	55 min.	0.09	0.14	64	447
Graphited	55 min.	0.02	0.13	57	255

1. Rockwell Hardness, E scale 100 Kg. Load—⅛" ball.
2. Wear Rate Loss of weight in grams—1 hour run, 1" I.D. bushing at 400 R.P.M.—.005" clearance—25 lb. per sq. in. pressure—no lubrication.
3. Coefficient of Friction—as determined on J. B. Machine. No lubrication.
4. Resistance to pounding—number of blows of 60 lb. hammer falling 2" to deform specimen .001"—1" x 1" x 1/16" specimen.
5. Same as (4) with deformation going to .005".

Specifications

	Standard Wall Thickness	For Shaft Diameters
1.	.032—.035	From 5/16" to 1½" Shaft
2.	.042—.045	From ⅜" to 1¾" Shaft
3.	.062—.065	From ⅝" to 2¾" Shaft
4.	.092—.095	Over 1¼" Shaft

In order to obtain the best results from Pre-Cast Bearing BRONZE-ON-STEEL bushings and bearings, it is advisable to include the following information in your specifications:

1. SIZE of hole bushing is to be pressed into—rather than O.D. of bushings.
2. SIZE I.D. required after pressing into place. Manufacturers standard tolerance .002.
3. TYPE of body or housing bushing is pressed into.
4. SPECIAL FEATURES of bushing should be fully explained including their purpose.

Thrust Washers

While BRONZE-ON-STEEL was developed primarily for Bushings and Bearings it also fills many other important industrial uses. It is ideal for applications requiring a flat bearing surface such as plates, washers, etc.

Some manufacturers prefer to purchase BRONZE-ON-STEEL in rolls and do their own stamping and forming. For such cases we can furnish it in rolls up to 400 feet in length. The maximum width of the strip cannot exceed 6½ inches.

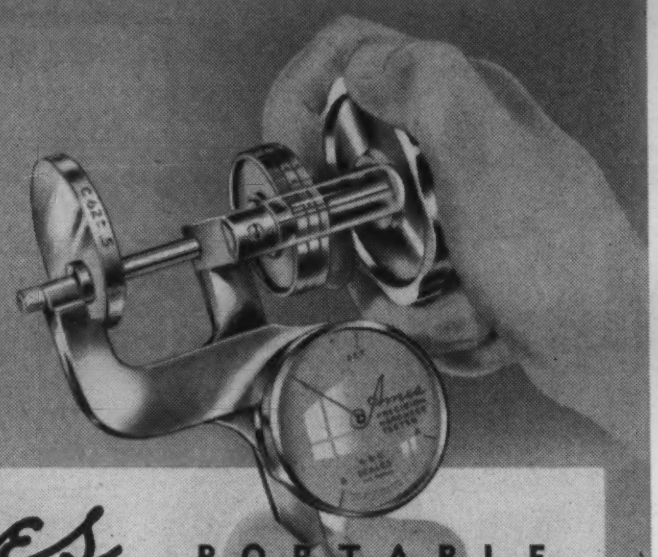
●

This bearing data sheet is but one of a series. You can get the complete set by writing to—

Johnson Bronze

SLEEVE BEARING HEADQUARTERS
769 S. Mill St. · New Castle, Pa.

For quick, accurate, on-the-spot hardness testing, reading directly in the Rockwell scales.



Ames PORTABLE
HARDNESS TESTER

Flat and round bars, sheets, tubing and wire are tested on the spot without cutting off specimens. Punches, dies, cutters, saws and odd-shaped pieces are tested before and after heat treating. Used by metallurgists, inspectors and heat-treaters. Sizes for work 1" to 6" round and flat. Send for illustrated circular.

See Exhibit National Metal Exposition, Cleveland. Lower Hall Booth No. 2817.

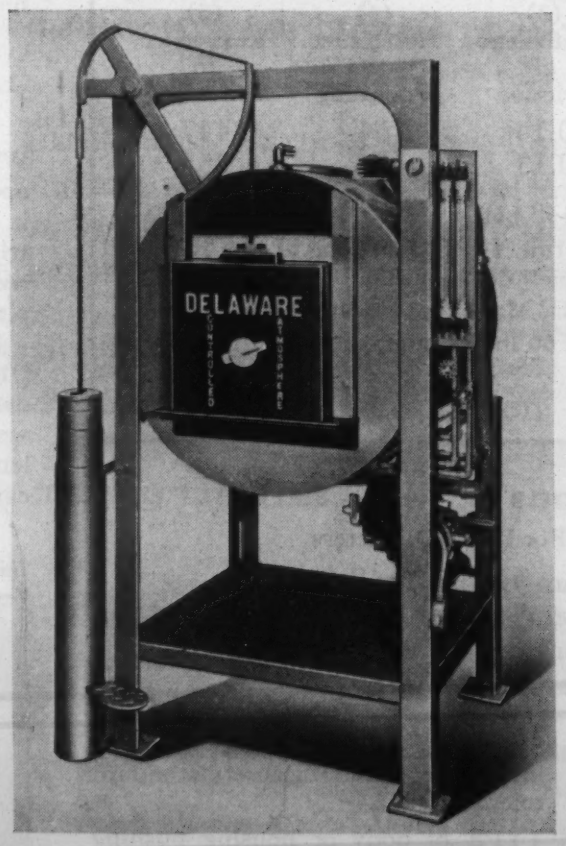
AMES PRECISION MACHINE WORKS
Makers of Precision Bench Lathes & Milling Machines
WALTHAM 54, MASSACHUSETTS

DELAWARE
Controlled Atmosphere Furnace
"The One Furnace for All Steels"

Here is the furnace that gives you *quality results* at lowest operating costs through—

- The use of one furnace for all work from 1200°F to 2800°F
- Fuel economy
- Elimination of grinding after hardening
- Low maintenance costs

DESCRIPTIVE LITERATURE AT YOUR REQUEST



DELAWARE TOOL STEEL CORP.
Wilmington, Delaware

News Digest (continued)

Technical Paper Contests Cover Plastics, Enameling, Cast Steel

Subjects of three technical paper contests announced recently are: the plastics industry; porcelain enameling of metals; and use of cast stainless steel in the chemical industry.

For the third consecutive year, the Society of Plastics Engineers is sponsoring a contest for the best three original articles, theoretical or practical in nature, dealing with some aspect of the plastics industry. Length of the article is restricted to 5000 words, exclusive of diagrams and pictures. Only articles not previously published will be considered by S.P.E., which holds first publication rights on papers submitted. In addition to certificates of award and national prizes of $200, $100, and $50, respectively, local section prizes will also be awarded. Contest deadline is Nov. 1, 1949. Entries should be addressed to the national office of S.P.E., 409 Security Bank Bldg., Athens, Ohio.

The Central Research Div. of Ferro Enamel Corp., Cleveland, Ohio, is seeking five prize-winning papers on any phase of technology related to porcelain enameling of metals from graduate and undergraduate students in United States and Canadian ceramic and ceramic engineering schools. Prizes, of $500, $300, $100, and two $50 prizes will be awarded. The competition will end Mar. 15, 1950, and awards will be announced at the annual meeting of the American Ceramic Society, which will be held April 24 in New York.

The first of a series of contests on the use of cast stainless steel, sponsored by Cooper Alloy Foundry Co., Hillside, N. J., will deal with applications in the chemical industry. Three cash prizes of $250, $150 and $100, and 100 additional prizes consisting of elaborate cast stainless steel paperweights will be offered. Deadline for this contest is May 1, 1950. Future competitions are planned to cover the food, textile, paper and pulp, aircraft, petroleum, marine and other industries.

Location of the Aluminum Alloy Division, Vanadium Corporation of America, near Chester, Pa. Leased from War Assets Administration.

NEW SOURCE OF ALUMINUM-RICH ALLOYS

FOR THE ALUMINUM AND STEEL INDUSTRIES

Our Aluminum Alloy Division, with headquarters at Chester, Pa., has begun commercial production of aluminum-rich alloys to serve the aluminum industry and to supplement the deoxidizers we have supplied for many years to the steel industry. The grades and compositions offered are:

FOR STEEL

Grade 1	95 to 97% Aluminum
Grade 2	92 to 95% Aluminum
Grade 3	90 to 92% Aluminum
Grade 4	85 to 90% Aluminum

Ingots, notch bars, shapes (stars, rings, etc.), shot and grain—for deoxidation and grain size control.

FOR ALUMINUM

Vanadium-Aluminum	2½, 5 and 10% V
Titanium-Aluminum	2½ and 5% Ti
Silicon-Aluminum	5 to 20% Si

For alloying, for grain refinement, and for improving the mechanical properties and fabricating qualities of numerous aluminum alloys.

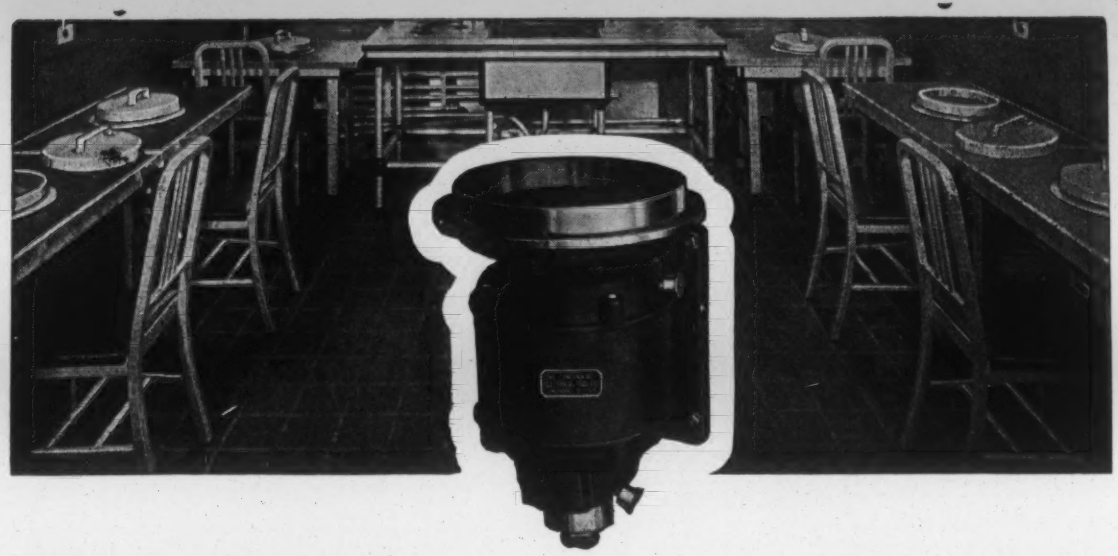
Careful supervision of manufacture in the largest electric furnace ever built for the melting of aluminum, combined with close spectrographic control, assures quantity production of quality material.

Write us for details as to how these products can serve you

MAKERS OF ALLOYS — VANCORAM — CHEMICALS AND METALS

VANADIUM CORPORATION OF AMERICA

420 LEXINGTON AVENUE, NEW YORK 17, N. Y. • DETROIT • CHICAGO • CLEVELAND • PITTSBURGH



The Cincinnati METALLOGRAPHIC POLISHING MACHINE produces SCRATCH-FREE SPECIMENS EVERY TIME!

Features

- No belts, no friction drive — direct-connected.
- No excessive noise or vibration.
- No splashing of polishing materials.
- Bronze bowl, disk and ring resist corrosion.
- Ball bearing throughout.
- Easy to clean.

The Cincinnati Variable Speed Polishing Machine sets a new standard of efficiency for smoothness and simplicity of operation in the preparation of specimens for microscopic examination . . . uniformity and scratch-free surfaces are achieved consistently — even with inexperienced operators — because of the smooth running, direct connected, variable speed motor which gives a range of speeds between 300 and 3,000 R.P.M. Write for Bulletin S9 for full descriptive details.

THE CINCINNATI ELECTRICAL TOOL CO.
2685 Madison Road Cincinnati 8, Ohio

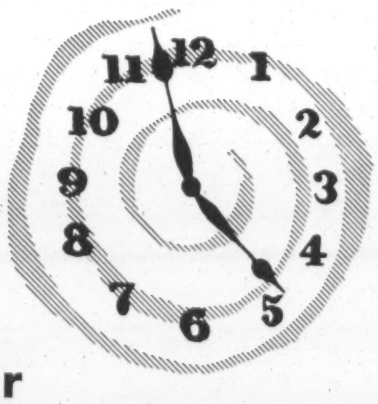
PQ SILICATES FOR FABRICATING METAL CLEANERS

Metso Granular
($Na_2SiO_3.5H_2O$) Sodium Metasilicate. Free-flowing, white granular product.

Metso 99
($Na_3HSiO_4.5H_2O$) Sodium Sesquisilicate. White, granular, free-flowing.

G-C
($Na_2O.2SiO_2$) Powdered Sodium Silicate. Hydrated, alkaline. Readily soluble.

G Silicate
($Na_2O.3.22SiO_2$) Hydrated powdered sodium silicate (sometimes referred to as trisilicate), rapidly soluble.



is your cleaner meeting schedules?

Does it keep up with time requirements of your cleaning and plating cycles? PQ Silicate Cleaners meet the time test easily. Parts are in and out of the bath in one minute flat, and even less, with the surface chemically clean for plating or other finishing.

The rates of removal of soils with Silicate Cleaners are fast, e.g., removal of paraffin soil from Dow metal with Metso Granular or Metso 99 required only 0.5 minute; red oxide buffing compound, 3 minutes and 1.5 minutes respectively.

Specify PQ Silicate content in your cleaners for fast, thorough grease removal.

PHILADELPHIA QUARTZ COMPANY
1133 Public Ledger Bldg., Philadelphia 6, Pa.

Sodium Sequisilicate U. S. Pat. 1948730, 2145749
Sodium Metasilicate U. S. Pat. 1898707

News Digest (continued)

NBS Ceramics Superior to Metals in High Temperature Strength

Several ceramic bodies previously developed by the National Bureau of Standards have strength and creep characteristics at 1800 F and above superior to the best available high temperature metal alloys, according to a report on recent tests issued by the Bureau.

The six ceramics tested were especially designed for use in jet engines and gas turbines and were superior to any obtainable from commercial manufacturers in 1944.

Tensile strengths for some compositions up to 18,000 psi. at 1800 F and 15,000 psi. at 1900 F were observed. Above 1900 F, the strengths dropped off rapidly to an average of about 5,000 psi. at 2000 to 2200 F.

Maximum observed creep rates for all the oxide bodies tested ranged from about 0.0001 to 0.0002% per hr. at 1700 F for the range of stresses used; from 0.0002 to 0.0008% per hr. at 1800 F and a stress of 16,000 psi.; and from 0.0030 to 0.0040% per hr. at 1900 F and 10,000 psi.

Rupture stress for the strongest oxide bodies reached a maximum of about 18,000 psi. at 1800 F. Two compositions retained about 16,000 psi. rupture stress at 1900 F but the others fell off rapidly above 1800 F.

Chemical Dip Polishing Process Simplifies Finishing of Metals

A chemical polishing process which gives metals bright, reflective surfaces without mechanical or electrical operations has been developed recently by Battelle Memorial Institute, Columbus, Ohio. Only a short dip treatment is required to produce a high lustre.

The polishing baths are mixtures of acids, principally phosphoric, nitric and acetic. They can be operated at room temperature up to 200 F, action of the bath being more rapid in the higher temperature range. Immersion

Uniform Plating Voltage

within ±2% automatically with G-E "Packaged Power" Rectifier Units

Here is a way to secure uniform plating from your large plating tanks. With General Electric "2000" *Packaged Power* Rectifier Units—equipped with motor-driven induction control—the d-c output is automatically held within ±2% of the selected voltage. *This—regardless of fluctuations in line voltage or tank load—and without attention by the operator.*

Flexibility—with "Packaged Power"

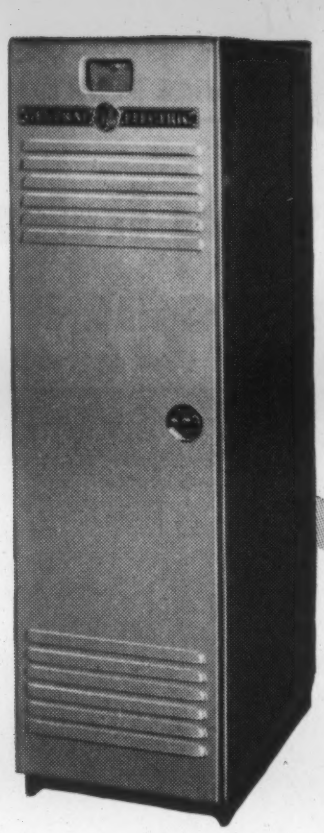
"Packaged Power" means decentralized power—with one package to power one tank at the voltage you want without rheostat losses. Each package contains its automatic control, its operator's control box and one to twenty or more rectifiers. To meet changing production needs, rectifiers may be grouped in parallel for heavy-current loads or in series for higher voltages. Additional rectifiers can be added or the entire package can be shifted easily, quickly.

High Efficiency—with "Packaged Power"

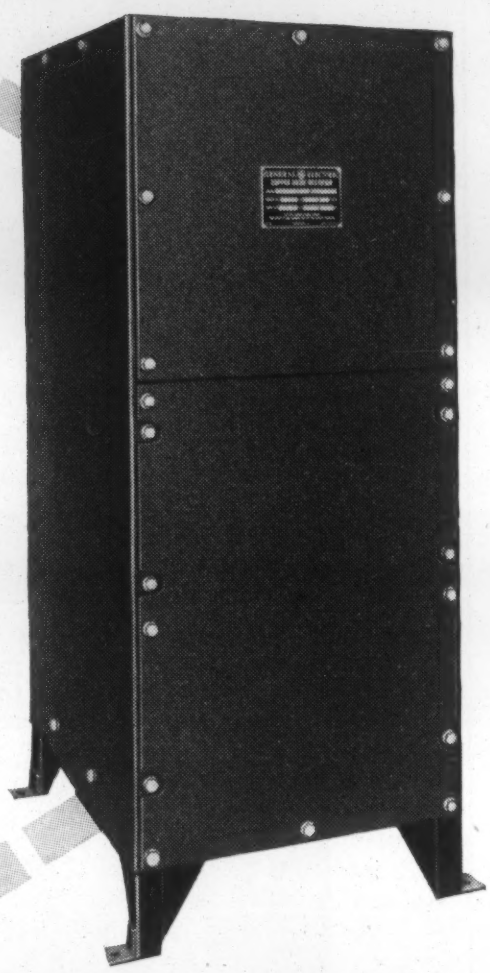
"Packaged Power" rectifiers cut your power costs. Their efficiency is better than 70 per cent from half-load to full-load—approximately 60 per cent even at quarter-load. Because these rectifiers use slow-aging copper-oxide stacks, efficiency continues high throughout their virtually unlimited life.

—And there's more to "Packaged Power"

Yes, there are other advantages for you with "Packaged Power." There's low initial cost, low amortization cost, full mechanical and electrical protection, and more—including the smaller 300-amp and 500-amp packages. We'd like you to have the whole story. Ask for Bulletin GEA-5247—"General Electric Copper-Oxide Rectifiers and Controls." *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



Automatic Control—This control is motor-driven and fully automatic—maintains tank voltage within ±two per cent of any selected voltage. Of induction type, this control gives smooth uninterrupted adjustment of d-c voltage—*under load*. In a "Packaged Power" unit, this control will handle one to twenty rectifiers. (2000 to 40,000 or more amperes.)



"2000" Rectifier—This rectifier is especially well suited as a power supply for large tank and barrel plating as well as for cleaning and electroplating. Complete within itself, it contains long lived copper-oxide stacks and is fully protected from electrical and mechanical failures. Basically a 2000-ampere 6-volt unit, it is also available in other voltage-ampere combinations totalling 12 kw. One to twenty or more rectifiers may be included in one "Packaged Power" unit.

TO TANK

Operator's Control Box—A small separate panel installed at the plating tank. Has push buttons for START and STOP and for selecting plating voltage. Highly accurate voltmeter and ammeter show tank conditions.

—Wide Current Selection with "Packaged Power"

"Packaged Power" units in multiples of 12 kw, are available for outputs of 3 to 48 volts and 1000 to 40,000 amperes. Virtually any practical combination of current-voltage ratings are available within these wide limits.

GENERAL ELECTRIC

456-302

ANOTHER 3M COMPANY SERVICE STORY

Interior coating licks gas tank corrosion

1. POURING measured dose of free-flowing vinyl-based "Coro-Gard" No. 11 into welded gas tank for Schramm Compressor. Purpose, to give interior a coating impervious to gasoline or water, prevent rust.

2. ROCKING the closed tank sloshes coating into every nook and cranny. After 24-hour draining and drying welded seams and fittings are covered with thin, even film, adhering perfectly to entire inside surface.

3. FINISHED UNIT ready for delivery. Thanks to "Coro-Gard" gas tank now withstands corrosion caused by water, other fuel impurities. Send us details on your coating problem. Production-engineering help free.

CORO-GARD BRAND ANTI-CORROSION COATING

Made in U.S.A. by

MINNESOTA MINING & MFG. CO.

St. Paul 6, Minn.

Also makers of "Scotch" pressure-sensitive tapes, "Underseal", "Scotchlite", "3M" Abrasives

Adhesives and Coatings Division,
411 Piquette Avenue, Detroit 2, Michigan

periods vary from 10 sec. to 10 min., depending on the initial finish of the treated surface, the final finish required, and the operating bath temperature. Following the dip, the work is rinsed and dried. Plating over the polished surface can be done without further treatment of the surface.

Metals which have been polished successfully include brass, copper, nickel-silver, Monel, nickel and aluminum. Chief advantage of the process is simplicity; as many as four or five production steps have been eliminated in certain metal-finishing applications.

Letter to the Editor

To the Editor:

I wish to call attention to the inclusion of obsolete theory in the otherwise excellent article entitled "Simplified Methods of Cleaning Metals for Plating," by J. L. Bleiweis, that appeared in the September 1949 issue of "Materials & Methods."

The action of a modern alkaline cleaner containing balanced surface-active agents is no longer considered to be due primarily to saponification and emulsification. Instead it is postulated that such detergent action depends chiefly on wetting power; that is, on whether the soil or the detergent solution wets the metal being cleaned more easily. Detergency is thus the displacement of the soil from the metal by the cleaning solution thru preferential wetting. Redeposition of soil on the metal being cleaned is prevented, then, not by emulsification of the displaced oil, but by the greater adhesion tension of the detergent solution to the metal than that of the soil to the metal.

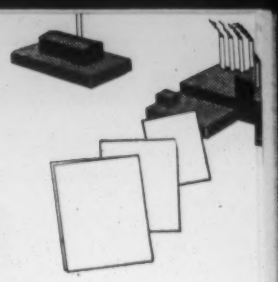
Another theory considers the detergent mechanism to consist of three parts: first, detergent molecules are adsorbed on the outer surface of the soil; second, the adsorbed detergent molecules migrate to the interior of the soil by capillary penetration, peptizing the soil; and, third, the peptized particles are removed from the metal by emulsification. However, the former theory is more widely supported. Saponification as a factor in detergency is almost entirely discredited.

Yours truly,

A. Mankowich,

Darlington, Maryland

(More News on page 166)



MANUFACTURERS' LITERATURE

Materials

Iron and Steel

Stainless-Clad Steel. Mechanical properties, forming characteristics and industrial applications of Permaclad, stainless-clad plain carbon steel, are discussed in a new folder prepared by Alan Wood Steel Co. Permaclad is used for bus bumpers, deep freezing units, shower stalls, chemical and food vessels, etc. (1)

Heat Resisting Alloys. A 14-page, illustrated bulletin on Pyrasteel alloys, chromium-nickel-silicon combinations possessing high tensile strength at high temperatures, is available from Chicago Steel Foundry Co. A discussion of mechanical properties and fabricating characteristics of the heat and corrosion resisting alloys is included. (2)

Corrosion Resisting Sheet and Plate. An 8-page, illustrated bulletin, No. 502, issued by the Duriron Co., gives properties, applications and available forms and sizes of Durimet 20 sheet and plate. Durimet 20 is a low-carbon austenitic stainless steel possessing corrosion resistance superior to 18:8 but retaining approximately the same working characteristics. (3)

High-Speed Steels. A 12-page, illustrated booklet prepared by Jessop Steel Co. gives information on composition, heat treatment, fabrication, applications and available forms for Supremus, Purple Label, Purple Label Extra, Mogul and Mustang M-2 high-speed steels. These steels are of the tungsten-molybdenum type. (4)

Steel Purchasing. Correct methods of specifying and buying alloy steel are covered by a 24-page booklet published by Joseph T. Ryerson & Son, Inc. The well-illustrated bulletin includes sections on alloy selection, alloy specifications, and identification of alloys received. (5)

Zinc-Coated Steel. Forming and finishing properties, available forms, and specific uses of Galvanite, a zinc-coated steel, are presented in this 12-page, illustrated bulletin. Galvanite, possessing high resistance to atmosphere corrosion and providing an excellent surface for paint or baked enamel, is manufactured by Sharon Steel Corp. (6)

Clad Metals. A 4-page, illustrated brochure on SuVeneer copper-clad, Monel-clad and nickel-clad strip is offered by Superior Steel Corp. The advantages in strength, ductility and corrosion resistance of the clad low-carbon steel are discussed and general applications listed. (7)

Stainless Steel. Two booklets containing extensive information on stainless steel can be obtained from United States Steel Supply Co. They are entitled "Introduction to Stainless Steel" and "Fabrication of Stainless Steel." (8)

Tool Steels. A 12-page, illustrated booklet issued by Vanadium Alloys Steel Co. contains exhaustive information on carbon and carbon-vanadium tool steels. Compositions, grade selection, mechanical properties, hardenability, microstructure, and heat treatment are included. (9)

Steel. Weirton Steel Co. has prepared a 12-page, illustrated bulletin describing its electrolytic zinc-coated sheets and strip, N-A-X High Tensile Steel, high carbon strip cold-rolled spring steel, cold rolled strip and sheets, and tin mill products. Compositions, properties and size and form specifications are included. (10)

Nonferrous Metals

Aluminum Design. A booklet containing 77 pages of illustrated, well-organized material on design details for aluminum is available from Aluminum Co. of America. Sketches, tables and diagrams on sand castings, permanent mold castings, die castings and forgings are included. Also featured is a 9-page list of references on aluminum. (11)

Bearing Metals. A 16-page, illustrated bulletin published by the National Bearing Div. of American Brake Shoe Co. contains concise information on physical properties of eight Babbitt metals, and extensive size and weight tables on "Tiger" bronze bar stock. Instructions for rebabbitting bearings are also included. (12)

Clad Metal. A series of data sheets on Rosslyn Metal, a clad metal consisting of two outer layers of stainless steel inseparably bonded to an interlayer of high conductivity copper, may be obtained from American Cladmetals Co. In addition to physical and mechanical properties, the data includes detailed information on welding, blanking, drawing and spinning of Rosslyn Metal. (13)

To obtain literature appearing on these pages, please refer to easy-to-use reply card on page 163.

Nonmetallic Materials

Properties of Glasses. Mechanical, thermal, electrical and chemical properties of Pyrex, Corning and Vycor commercial glasses are given in a new 14-page booklet, No. B-84, published by Corning Glass Works. Much of the material has heretofore never been assembled in this simple but comprehensive manner. (14)

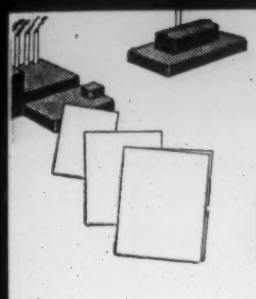
Neoprene. A discussion of the use of Neoprene parts, such as hose, diaphragms and protective coatings, where chemical resistance is required, is accompanied by extensive tabular data. This review highlights the series of eight articles making up the 12-page, illustrated *Neoprene Notebook* No. 43, published by Rubber Chemical Div. of E. I. du Pont de Nemours & Co., Inc. (15)

Silicone Rubber. General Electric Co. has published a 24-page, illustrated booklet, No. COP-584, describing its silicone rubber product. Thermal, mechanical, electrical and chemical properties of the material are listed, and fundamentals of silicone chemistry and performance of the rubber under varied conditions are discussed. (16)

Metal-Clad Plywood. A 20-page, illustrated bulletin prepared by Haskelite Manufacturing Corp. describes the fabrication, fastening and finishing of Plymetl, a metal-clad plywood having high strength and stiffness and higher sound deadening and insulating factors than are found in ordinary structural materials. Many applications are depicted. (17)

Plastic Molding. A 6-page, illustrated folder containing data on comparative properties of common plastics and facts about molding of plastics is available from Modern Plastics Corp. Photographs of various phases of the plastics molding process are included. (18)

Micarta. The applications and advantages of Micarta, industrial plastic, are discussed in a 36-page, illustrated booklet available from Westinghouse Electric Corp. Mechanical, electrical and chemical properties are given and grade selection tables for both laminated and molded Micarta are included. (19)



MANUFACTURERS' LITERATURE

Parts and Forms

Abrasion-Resistant Alloy. Physical properties, uses and advantages of castings of Thermalloy HC-250, an abrasion-resistant alloy, are listed in a 6-page, illustrated folder published by Electro-Alloys Div. of American Brake Shoe Co. The bulletin also includes case history data on field service, and information on machining and high temperature service. (20)

Permanent Magnets. A 24-page, illustrated bulletin on Alnico permanent magnets is offered by Arnold Engineering Co. The information includes magnetic properties, demagnetization and energy curves, resistance comparisons, physical properties, casting properties, heat treating characteristics, and finishing, assembly and cost considerations. (21)

Porous Bronze Bearings. This 16-page, illustrated bulletin lists hundreds of sizes and types of "Compo" oil-retaining porous bronze bearings carried in stock, and gives bearing formulae, tolerances, loads and specifications. Available from the Bound Brook Oil-Less Bearing Co. (22)

Metal Parts. Stampings, forgings, hydraulic equipment and assembled products are all covered in a 30-page, illustrated catalog published by Commercial Shearing & Stamping Co. Among the assembled products described are exhaust nozzles, oil reserve tanks, trash racks, heat exchange elements and steel treadways. (23)

Chromium-Nickel Castings. The Duraloy Co. has issued a 16-page, illustrated bulletin, No. 4729-G, describing the composition, properties and uses of their various chromium-iron, chromium-nickel and nickel-chromium castings. These castings, static and centrifugal, are generally produced for use where resistance to corrosion, high temperature and abrasion is necessary. (24)

Zinc Die Castings, Etc. Detailed specifications of both Junior and Senior type GRC nonferrous zinc alloy wing nuts that are rust proof and corrosion resistant, and illustrations of a variety of small zinc die castings, small injection moldings, etc. are featured in this 4-page bulletin, issued by the Gries Reproducer Corp. (25)

Welded Steel Tubing. A 16-page, illustrated bulletin available from Jones & Laughlin Steel Corp. describes Electricweld Tubing. Method of production, advantages, specific applications, available forms and sizes, and tolerances of the strong, light-weight welded steel tubing are covered. (26)

Cemented Carbide Parts. The composition, properties, fabricating characteristics and applications of the various grades of Kennametal cemented carbides are given in Catalog 49, prepared by Kennametal Inc. Detailed specifications for tools, wear-resistant parts and extruded shapes are included in this 76-page, illustrated booklet. (27)

Precision Parts. A new catalog published by Kohler Co. lists practical reference data on its complete line of precision parts for all aircraft, industrial and automotive installations. The parts include check valves, pressure relief valves, jet engine parts, vacuum valves, needle valves, engine primer pumps, and pipe, tube and hose fittings. (28)

Deep-Drawn Shapes and Shells. The Linde Air Products Co. has issued a 4-page, illustrated bulletin describing Prest-O-Lite deep-drawn shapes and shells and compressed gas cylinders. (29)

Glass Products. McKee Glass Co. has issued a 16-page, well-illustrated brochure on the applications of its glassware in commercial and industrial fields. Scientific and laboratory equipment and industrial machinery, *e.g.* the Godet spinning wheel are some of the uses covered. (30)

Meehanite Castings. A detailed tabular summary listing the physical properties of the general engineering types of Meehanite castings, produced by the Meehanite Metal Corp., is featured in this 4-page, illustrated bulletin, No. 32. (31)

Friction-Minimizing Bearings. A complete line of friction-minimizing, self-lubricating Morganite bearings, including metallic and nonmetallic content bearings, composite bearings and machined or molded shapes of special quality, self-lubricating materials, is fully described and illustrated in a 6-page folder released by Morganite, Inc. (32)

Zinc Alloy Die Castings. The more salient features of Zamak-3 and Zamak-5 zinc alloy die castings, the method of production and typical applications are all reviewed in this 28-page, illustrated booklet, available from the New Jersey Zinc Co. (33)

Die Castings. Advantages, properties and specific applications, including case histories, of aluminum, zinc and brass Parker die castings are described and illustrated in this new 8-page brochure offered by Parker White Metal Co. Also shown is the company's 16-point plan of production control. (34)

Aluminum Extrusions. A 4-page brochure, No. 524B, covering the various applications of aluminum extrusions has been issued by the Reynolds Metal Co. Commercial tolerances and specified mechanical properties are listed, as well as ordering data, tables on alloys and tempers, and nominal chemical compositions. **(35)**

Molded Inorganic Plastic. Rostone Corp. has prepared a 4-page, illustrated bulletin describing properties, molding design, applications and available forms of Rosite plastic moldings. The inorganic plastic forms are used in the electrical industry for arc shields, terminal blocks, brush holder studs, fuse blocks, etc. (36)

Wire. Seneca Wire & Manufacturing Co. has issued a 14-page catalog, No. 100, listing gages, weights, tempers and finishes of its wire products. Tables of hardness and tensile strength of wire of various gages are included. (37)

Wire Racks. Advantages of using welded-wire shelving and racks instead of sheet metal stampings are discussed in a 6-page, illustrated folder available from E. H. Titchener & Co. Examples of the use of welded-wire and wire-and-strip steel assemblies are shown. (38)

Precision Metal Parts. A 26-page, illustrated catalog listing precision metal parts produced by the Specialties Div. of Torrington Co. has been released. Among the parts included are awls, drills, electrodes, knives, mandrels, needles, perforating punches, studs and shafts. (39)

Coatings and Finishes

Hard-Facing Alloys. Longer equipment life through use of hard-facing alloys is discussed in a 6-page folder, No. B-401, circulated by Coast Metals, Inc. Four illustrated case histories, concerning muller tires, shredder knives, augers and hammers, portray the advantages obtained as a result of using welded wear-resistant overlays. (40)

Protective Paints for Steel. The results of a detailed experimental study of paints for enclosed structural members in steel housing construction are given in a 46-page bulletin published by AISI and available from Lead Industries Assn. Comparative moisture resistance data on many types of paint compositions make this booklet of interest to anyone concerned with the protection of steel surfaces against rust. (41)

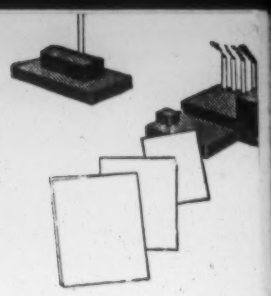
Methods and Equipment

Heat Treating and Heating

Surface Hardening. Gaseous carbo-nitriding, one of the most efficient methods of surface hardening ferrous alloys and readily adaptable to mass production procedures, is the subject of a bulletin published by the Ammonia Div. of Armour & Co. (42)

Pack-Hardening or Isolating Pastes. This 6-page, illustrated folder discusses Carburit, a new pack-hardening paste that hardens desired sections only, needs no special equipment, and penetrates the work rapidly, and Isopac, an easy-to-use isolating paste that keeps desired sections soft when hardening in box, salt bath or by other conventional methods. Denfis Chemical Laboratories, Inc. (43)

Radiant Tube and Roller Hearth Furnaces. Sketches and photographs of Gasmaco ra-



MANUFACTURERS' LITERATURE

diant tube and roller hearth furnace installations and actual case history data on performance are included in a 4-page bulletin circulated by Gas Machinery Co. Gasmaco furnaces provide low-cost heat treating in controlled atmospheres between 1700 and 2500 F. (44)

Heat Treating Unit. Ipsen Industries, Inc., has just released an illustrated 4-page brochure describing its series T fully automatic heat treating unit, sealed and atmosphere-controlled. Dimensions and capacities for Models T 250 and T 500 are included. (45)

Induction Heating. Results obtained from using Tocco induction heating for forming and forging of gears, shafts, pins, wheels, tubes and bars are given in a bulletin published by Ohio Crankshaft Co. Tocco induction heating is also applicable to hardening, brazing and annealing. (46)

Quenching Oil. Performance of R-2 mineral quenching oil in producing greater hardness in carbon steels with less distortion and 50% less carryout compared to other oils is described in a 12-page booklet circulated by Rodman Chemical Co. Laboratory test results included indicate hardening ability double that of oils offered by competitors. (47)

Rotary Hearth Furnaces. A discussion of the use of rotary hearth furnaces in the heating of steel and nonferrous metals has been published by Salem Engineering Co. The 8-page, illustrated bulletin covers development, adaptability, design, heat control, charging and discharging, and maintenance and repair of Salem furnaces. (48)

Speed-Heating. Use of the Gradiation Process for the speed-heating of metals is discussed in a 78-page, illustrated bulletin available from Selas Corp. of America. Metallurgical benefits of the process used with steel, copper and copper alloys, and applications to brazing, hardening, and heating for forging are covered. (49)

Gas-Fired Air Heaters. Performance characteristics of direct gas-fired air heaters manufactured by Surface Combustion Corp. are described in a 4-page, illustrated bulletin. Two graphs showing volume and heat content of air at elevated temperatures are included. (50)

Heat Treating Furnaces. The Industrial Heating Div. of Westinghouse Electric Corp. has issued an 8-page, illustrated bulletin, No. B-4054, describing its various types of gas-fired heat treating furnaces and their applications. Actual installations are pictured and explained. (51)

Heat Treating Accessories. This 16-page, illustrated catalog, published by Youngstown Welding & Engineering Co., describes welded Monel and Inconel baskets, crates, chains, hooks and accessories for use in pickling, annealing and heat treating. (52)

Cleaning and Finishing

Rust Remover. Five outstanding advantages received when using Diversey Everite for safely removing rust, heat scale, hard water scale and discolorations from metal surfaces are listed in this single, illustrated sheet issued by the Diversey Corp. (53)

Electroplating Rectifier. The electrical and mechanical characteristics, control types and component parts of the selenium electroplating rectifier, Model EPF 4304, are described in a 2-page bulletin, No. 248, available from Electric Products Co. This model has an output of 2000 amp. at 6 v. or 1000 amp. at 12 v. (54)

Polishing and Grinding Machinery. An illustrated 24-page catalog, No. 60, including descriptions of polishing, buffing, grinding and deburring machinery, is available from Hammond Machinery Builders, Inc. Information on a new and complete line of 10 Junior Automatics for use with polishing lathes or abrasive belt machines is presented. (55)

Polishing and Buffing Lathes. Nine different types of motor-driven polishing and buffing lathes are described and illustrated in Bulletin L-203, released by the Hanson-Van Winkle-Munning Co. (56)

Metallizing for Corrosion Protection. Examples of a variety of iron and steel equipment that were metallized with either zinc or aluminum, thus affording 15 to 20 years of protection against rust and corrosion, are described and illustrated in this 8-page bulletin, No. 62, offered by the Metallizing Engineering Co., Inc. (57)

Degreaser. A new booklet on Nialk Trichlorethylene, used as a solvent degreaser in the metal industries, is available from Niagara Alkali Co. A description of Niagara's recently-constructed plant for the production of this chemical is included. (58)

Dry Belt Surfacer. The Model B-3 10-in. dry belt surfacing machine, manufactured by Porter-Cable Machine Co., is described in detail in a 2-page, illustrated bulletin. Built for continuous duty, the B-3 is adapted to sanding, grinding or polishing of metals, woods, ceramics, etc. (59)

Surfacing Machines. The Production Machine Co. has released a 4-page, illustrated bulletin, No. 3, describing its horizontal and vertical types of Peerless surfacing machines. The machines are used for grinding and sanding flat surfaces of metal, wood, hard rubber, celluloid and molded composition. (60)

Welding and Joining

Castings Repair. An 8-page, illustrated reprint covering the repair of gray iron castings by welding is available from Air Reduction Sales Corp. The article contrasts oxyacetylene, electric arc, and carbon arc welding as applied to a forging hammer anvil base and other cast parts of industrial equipment. (61)

Stainless Steel Fasteners. All types and sizes of stainless steel machine, self-tapping socket, set and wood screws, and nuts, bolts, washers, rivets and pins are described and illustrated in bulletin No. 49E, offered by Allmetal Screw Products Co. (62)

Rods and Fluxes. This 32-page, pocket-size, illustrated handbook contains a complete list of All-State rods and fluxes, tables of characteristics, full application information, and helpful hints of general interest to workers in the metal-joining industries. Offered by the All-State Welding Alloys Co., Inc. (63)

Resistance Welding Slope Control. The new slope control for resistance welding, developed by General Electric Co., is described in Bulletin GEC-534. Used to regulate the rate at which current rises to welding value, this equipment reduces tip "pickup" in spotwelding aluminum and eliminates expulsion in projection welding. (64)

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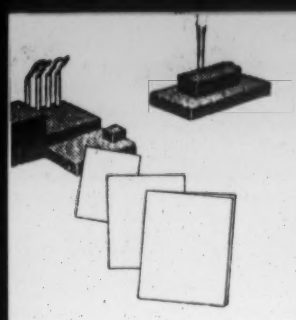

MANUFACTURERS' LITERATURE

Plastic Adhesive. Pliobond, a viscous thermoplastic adhesive used for a variety of bonding operations, is covered by a 24-page, illustrated bulletin prepared by the Chemical Div. of Goodyear Tire & Rubber Co. Detailed data on bonding of metal, wood, plastics, fabrics, glass and rubber are included. (65)

Silver Alloy Brazing. This 4-page bulletin, No. T-4, is Part Two of a series concerned with the strength of silver alloy brazed joints. The data, sketches and graphs covering impact, fatigue and high temperature properties of brazed joints were compiled by Handy & Harman. (66)

Weld Pads. Specifications for round, square, rectangular and flanged weld pads for projection welding are listed in Bulletin No. 485, issued by Ohio Nut & Bolt Co. Sizes, weights, minimum allowable thickness of sheet, and sizes of press welder required are included. (67)

Shield Can Fasteners. A single data sheet on fastener, can and chassis details for shield can fasteners is available from Palnut Co. Particular advantages and principle of operation of these special fasteners are also discussed. (68)

Forging and Forming

Dry Lubricant. Molykote, a smooth-textured molybdenum-disulfide powder used as a dry lubricant and anti-seizing compound, is the subject of a 4-page bulletin, No. 52, issued by Alpha Corp. Technical information on corrosion properties, electrical conductivity, and chemical and thermal stability is included and applications in machinery and metal forming are discussed. (69)

Hydraulic Presses. Illustrations of 37 hydraulic presses being used for forming and drawing, forging, extrusion, plate working, bending, crimping, joggling, straightening, powdered metal parts, railroad shop operations, and other special work are included in a new 12-page bulletin, No. 285, available from the Baldwin Locomotive Works. (70)

Hydraulic Presses. A collection of 17 case histories in which use of H-P-M Fastraverse presses resulted in reduction of metal working costs has been issued as a 19-page bulletin by Hydraulic Press Manufacturing Co. Well-illustrated, the release cites performance data as supplied by various manufacturing companies. (71)

Machining

Sintered Carbide Tips, Tools, Etc. Specifications and prices of a complete line of Firthite sintered tungsten carbide tips and tools, boring bits, Mechanigript adjustable tool holders, and special tips, nibs and wear parts made to customers' specifications are featured in this 28-page, illustrated catalog, No. FE-127, offered by the Firth Sterling Steel & Carbide Corp. (72)

Melting, Casting and Molding

Aluminum Bronze Die Casting. Advantages and specific applications of the vacuum die casting process as applied to aluminum bronze are discussed in an 8-page, illustrated brochure circulated by Aurora Metal Co. Chemical composition and physical properties of six Aur-O-Met alloys are also given. (73)

Inspection and Control

Portable Pyrometer. Bulletin 400, issued by Charles Engelhard, Inc., describes a self-contained portable precision pyrometer which gives accurate and instantaneous readings regardless of thermocouple resistance or length of connecting lead. (74)

Combustion Boats. A single sheet bulletin listing sizes and prices of ceramic barge-type boats available for gravimetric carbon analyses has been released by Laboratory Equipment Corp. The boats are known as Leco HF series. (75)

Immersion Pyrometer. Bulletin No. 150, four pages, describes and illustrates two models of the new Pyro immersion pyrometer with instantly interchangeable "Bare Metal" and "Protected" type thermocouples for use in all nonferrous industries. The Pyrometer Instrument Co. includes specifications in this new bulletin. (76)

General

Vibration Isolation. Fundamental principles underlying the use of wool felt for vibration isolation of machinery, and practical data for specific applications are included in this 6-page Data Sheet No. 10, issued by American Felt Co. The bulletin also presents detailed formulae for use in designing for proper felt isolation. (77)

Coated Abrasives. The Carborundum Co. has published a 32-page illustrated book presenting the outstanding features of its new service, research and production facilities at Wheatfield, N. Y., designed for development and manufacture of coated abrasive products. (78)

Photomicrography and Electron Micrography. This 32-page booklet contains brief bibliographies in the fields of application of all types of photomicrography and electron micrography, but without separate classification. Available from the Eastman Kodak Co. (79)

Industrial Uses of Radioactive Materials. A selected bibliography on the industrial uses of radioactive materials, consisting of 22 pages, is offered by Arthur D. Little, Inc. General background references, survey articles of industrial applications, and references dealing with a specific field are included. (80)

Vibration Control. The use of bonded rubber shear type mountings for vibration control is discussed by Lord Manufacturing Co. in an illustrated 20-page bulletin, No. 104. Readable charts on basic engineering principles and specific applications of vibration isolation are included. (81)

Production Control. A 6-page, illustrated folder prepared by Remington Rand lists 16 ways to speed production and save money. Use of Kardex records for synchronization of purchasing with future production requirements is emphasized. (82)

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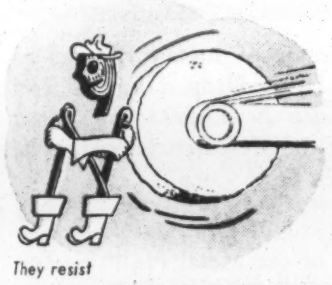

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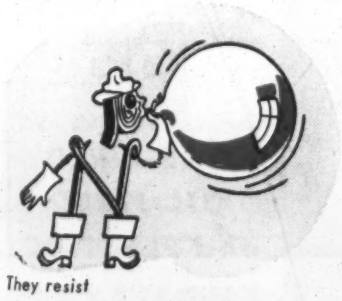
ABRASION, CUTTING, CHIPPING—are tough and durable under severe service conditions.



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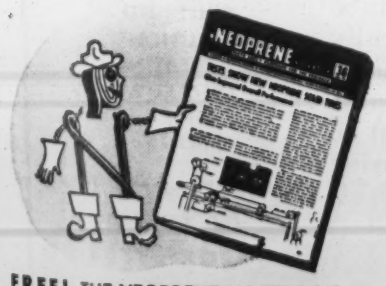

FREE! THE NEOPRENE NOTEBOOK—Interesting stories...new, unusual applications of neoprene. Write E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division A-10, Wilmington 98, Delaware

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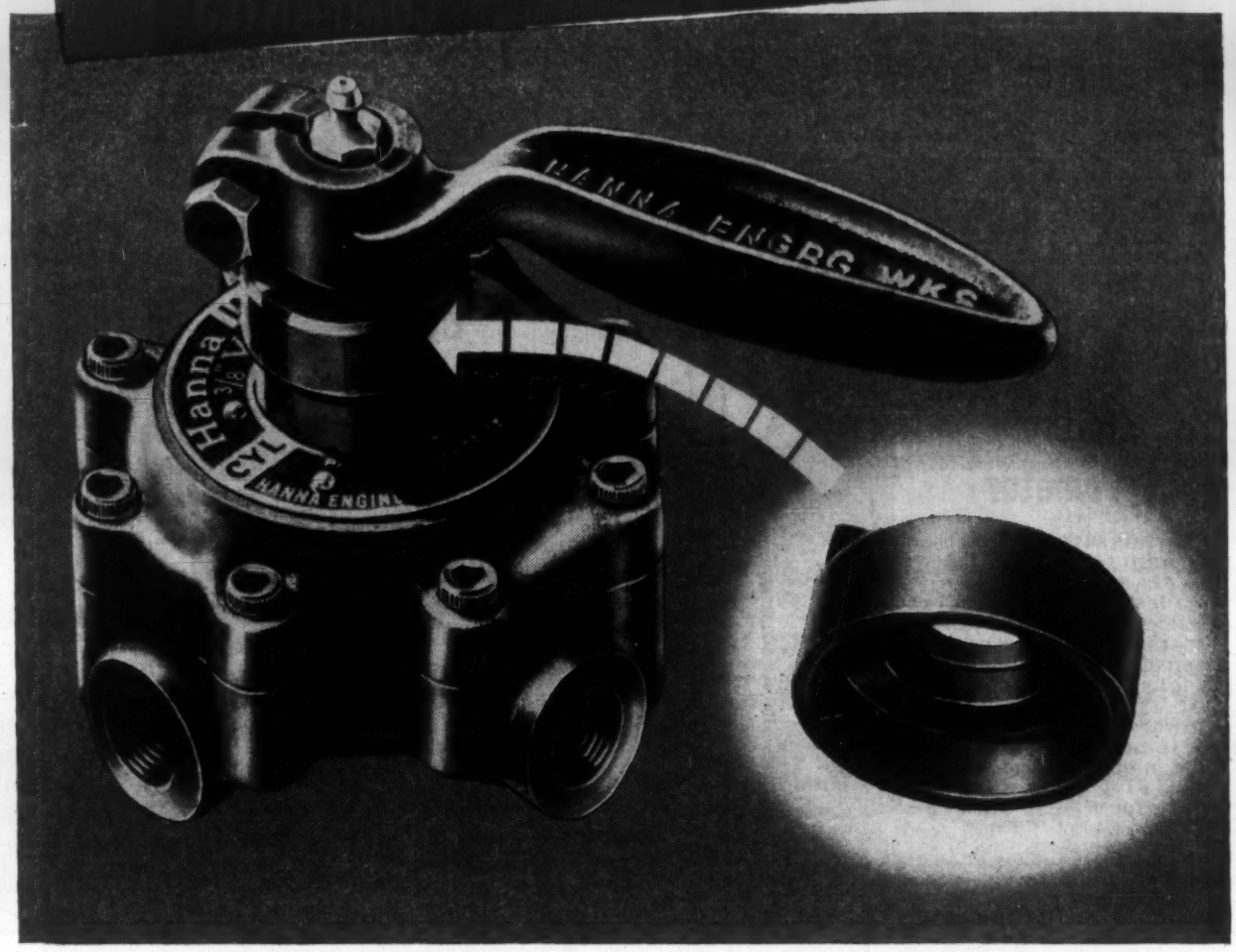

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Designed to handle air, oil or water, this new packless valve eliminates the trouble and expense of replacing worn packings and gaskets. But during development, engineers of the Hanna Engineering Works found that dirt and abrasive matter in mills, foundries and factories could work down the valve stem into the valve. So they added a cap of molded neoprene to fit snugly around the valve stem and bonnet.

The resilient neoprene cap maintains a tight, positive seal at the valve stem. Yet it is tough and durable . . . withstands cutting and abrasion. Neoprene does not deteriorate in contact with oils, grease, chemicals or solvents. It resists weather, aging, heat and cold. And the engineers report neoprene easy to mold . . . reasonable in cost.

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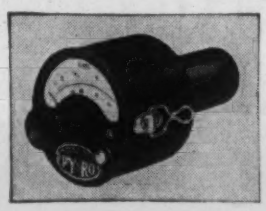

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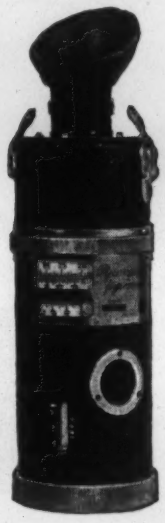
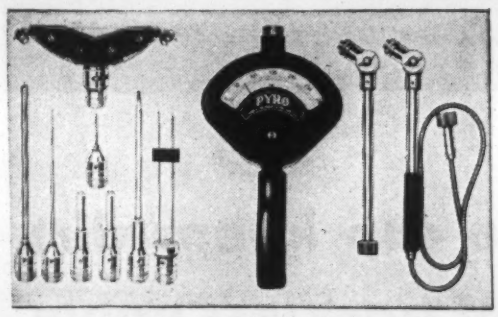


Determines temperatures of minute spots, fast-moving objects and smallest streams — at a glance! No correction charts or accessories needed. Easy to use—weighs only 3 lbs. Special types available to show true spout and pouring temps. of molten ferrous metal measured in open. Five temp. ranges. **Write for FREE Catalog No. 80.**



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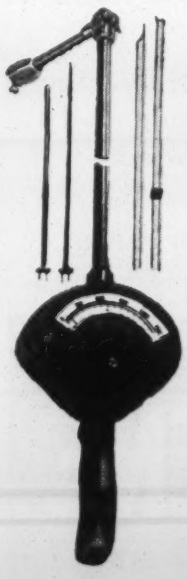

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News of...

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Engineers

Richard H. Marshall has joined the metallurgical staff of the Climax Molybdenum Co. Mr. Marshall, formerly production metallurgist of the Timken Roller Bearing Co., will work with the staff in Chicago.

Fairbanks, Morse & Co. has announced the appointment of *Frank M. Mason, Jr.* as director of engineering. He was manager of the Research Division of the company for several years, and will continue to maintain his headquarters at the Chicago office.

The operating department of the Youngstown Sheet & Tube Co. has added Dr. *John E. Stukel, Jr.* to its staff as a development engineer. Dr. Stukel previously served as assistant professor at the Carnegie Institute of Technology.

G. L. MacLane, Jr. has been appointed manager of the Engineering Laboratories of the Westinghouse Electric Corp. He succeeds *Thomas L. Spooner,* who retired after 40 years of service with Westinghouse.

The addition of *Peter M. Reif* to its Mechanical Engineering Dept. has been announced by Horizons, Inc.

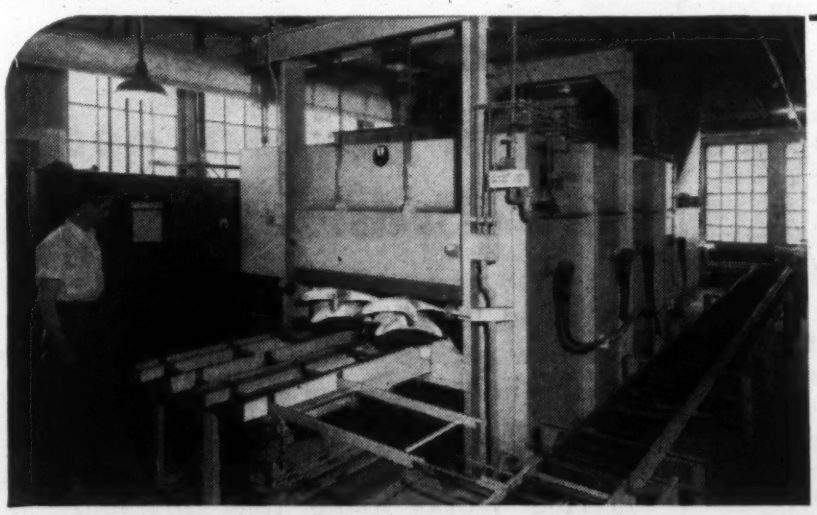
The Eutectic Welding Alloys Corp. has augmented its research staff with the addition of Dr. *Eugen Sovegjarto,* welding alloys research expert formerly employed by leading metallurgical concerns in Germany.

Robert H. Davies has joined the Baker-Raulang Co. as manager of engineering, in which capacity he will supervise all engineering functions for the company. Mr. Davies previously was connected with the Lincoln Electric Co.

The Air Reduction Sales Co. has appointed *Frank J. Aschenbrenner* and *Earl C. Clark* as assistant directors of research and engineering. Mr. Aschenbrenner will be in charge of Air Reduction's Murray Hill, N. J. laboratory, while Mr. Clark assumes charge of the development and engineering groups.

The new director of metallurgy and research for the Utica Drop Forge & Tool Corp. is Dr. *Falih N. Darmara,* a former staff member of the Research Laboratory of the United States Steel Corp.

The appointment of Dr. *Paul J. Brodeur* as chief chemist of the Metal Finishing Div. of the Pyrene Manufacturing Co. is in con-



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Salem - Ohio

For better results in treating metals: Specify these long-lived Norton Refractories

tubes

Alundum Refractory tubes are made in a variety of sizes for electric furnaces of the metal resistor type. Because of the excellent electrical qualities of Alundum the resistor can be wound directly in the tube. They are used largely in furnaces for wire drawing, particularly tungsten and molybdenum and for sintering cemented carbides. Crystolon tubes can be supplied in the same sizes for many high temperature operations where electrical insulation is not a factor. Alundum is also available as thermocouple tubing and as pyrometer tubes, both ideal, for protecting costly thermocouples in temperature recording devices.

cores

Alundum cores are very useful in furnace manufacture. They have all the properties of Alundum tubes with the added physical feature of being molded with grooves for retaining the resistor wire. For the operator who must prepare a special furnace on the job, cores are a great help because the resistor can be applied easily and simply in the spacing provided.

The resistor may be spiralled or straight and wound in the grooves and then embedded in Alundum cement. Thus, fully protected, the wire is less liable to corrode since these mixtures are chemically inert. Alundum cores have high heat conductivity and do not become electrical conductors even at high temperatures.

muffles

One-piece muffles of both Alundum and Crystolon can be provided, rectangular, "D" shape and "U" shape for building small furnaces heated by oil, gas or electricity. Such furnaces are used in a great variety of operations and most prefabricated furnaces on the market have furnace chambers formed by muffles of one or the other of these materials. Only Crystolon muffles are carried in stock, but Alundum muffles are gladly supplied on order. Alundum muffles are used primarily where electrical resistance is desired at temperatures above 1250° C. In electric furnaces the resistance wire encircling the muffle should be embedded in Alundum cement.

small furnace refractories

mixture designation	composition	structure	shapes available	remarks
RA 98*	alumina 89%	fine	cores, tubes, muffles and most special shapes	subject to reduction of silica above 1450° C. in reducing atmosphere.
RA 1139*	alumina 99%	fine	cores, tubes, muffles and many special shapes	used to 1650° C. but subject to distortion above 1550° C. under load.
RA 1192*	alumina 99-%	fine	tubes and certain flat and simple shapes	used to 1750° C. but subject to some distortion above 1600° C. under load.
RA 1213	alumina 99-%	medium	tubes, certain cores, muffles, and flat and simple shapes	used to 1900° C., little distortion in use to 1800° C.
RA 1191	alumina 99-%	coarse	tubes, certain muffles and flat shapes	used to 1900° C., little distortion to 1850° C.; coarse grained surface.
RC 217*	silicon carbide 65%	fine	cores, tubes, muffles and special shapes	reduction, oxidation and electrical conductivity increase with temperature; not recommended for use above 1100° C.; suitable for use with base metal resistors only.
RC 1138	silicon carbide 83%	medium fine	some cores, tubes, muffles and special shapes	reduction, oxidation and electrical conductivity increase with temperature; not recommended for use above 1450° C.; suitable for use with base metal resistors only.

*suitable electrically heated furnaces only.

refractory cements

In the construction of externally wound electric furnaces, tubes and muffles are covered with a cement to hold the resistor in place and to protect it from contamination by materials which might damage it. Norton cement mixtures are composed of Alundum grain, suitably sized, to which is added a ceramic binder. Norton refractory cements used for imbedding resistor elements are purposely designed to reduce possible reaction to the minimum.

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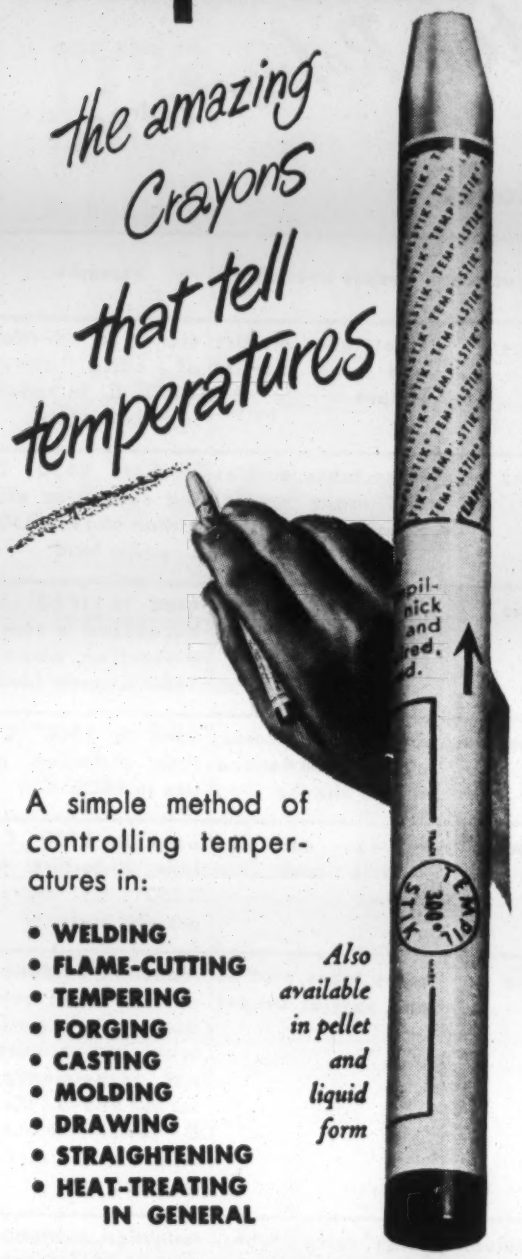
Tempilstiks°

the amazing Crayons that tell temperatures



A simple method of controlling temperatures in:

- **WELDING**
- **FLAME-CUTTING**
- **TEMPERING**
- **FORGING**
- **CASTING**
- **MOLDING**
- **DRAWING**
- **STRAIGHTENING**
- **HEAT-TREATING IN GENERAL**

Also available in pellet and liquid form

It's this simple: Select the Tempilstik° for the working temperature you want. Mark your workpiece with it. When the Tempilstik° mark melts, the specified temperature has been reached.

$2 each

gives up to 2000 readings

Available in these temperatures (°F)			
125	275	500	1100
138	288	550	1150
150	300	600	1200
163	313	650	1250
175	325	700	1300
188	338	750	1350
200	350	800	1400
213	363	850	1450
225	375	900	1500
238	388	950	1550
250	400	1000	1600
263	450	1050	

FREE —*Tempil° "Basic Guide to Ferrous Metallurgy"* — 16¼" by 21" plastic-laminated wall chart in color. Send for sample pellets, stating temperature of interest to you.

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News of... ENGINEERS COMPANIES SOCIETIES

junction with plans of an extensive expansion program for the division.

E. R. Koppel has been named assistant to the president-engineering of the Ingersoll Steel Div. of the Borg-Warner Corp. *W. W. Kovalick,* plant engineer, succeeds Mr. Koppel as chief engineer of the Division's West Pullman, Ill. plant.

Two promotions in the executive personnel of the Carnegie-Illinois Steel Corp.'s Gary Steel Works occurred recently. *Paul E. Thomas* was named assistant to the general superintendent, and *Daniel E. Wise,* chief engineer of the Clairton, Pa. Works of Carnegie-Illinois, succeeds Mr. Thomas as chief engineer of the Gary plant.

The Crucible Steel Co. has announced several changes in its executive staff. *R. S. Poister,* vice president and director of the company, now is in charge of all manufacturing operations. *Walter H. Wiewel,* who was appointed vice president in charge of sales, will retain his present position as president of the Trent Tube Co., a subsidiary of Crucible. And *M. E. Cummings,* formerly assistant to the president, was named assistant vice president in the operations department.

John C. Blake has joined the Phosphor Bronze Corp., assuming the position of general manager. He previously served as general sales manager of the Riverside Metal Co.

The position of executive vice president of the A. P. Green Fire Brick Co. has been filled by *William S. Lowe,* formerly associated with the Reeves-Ely Laboratories, Inc.

Two new members have been added to the staff of the Al-Fin Division of the Fairchild Engine & Airplane Corp. They are *George T. Ladd,* previously project engineer at the Wright Aeronautical Corp., who now is production engineer for Al-Fin; and *Howard W. Crusey,* a former service engineer at the Thompson Products Co., who was named sales engineer for the Division.

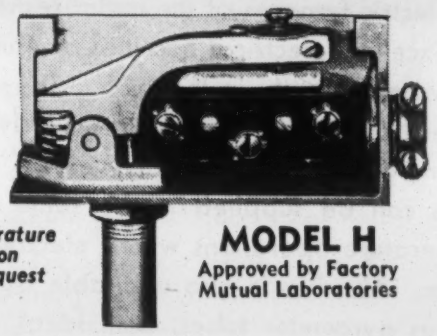
Malcolm S. Clark has resigned as president and member of the board of directors of the Federal Machine & Welder Co. He is succeeded by *A. S. Blagden,* executive vice president.

The Electro-Chemical Supply & Engineering Co. has announced a complete reorganization in conjunction with its expansion program. The new officers of the company are: president, Dr. *C. R. Payne;* vice president and sales manager, *J. Wm. Grant;* treasurer and production manager, *Wm. A. Sesher;* and advertising manager and export sales manager, *Walter L. Sheppard, Jr.* The company has also put into operation a new plant at Emmaus, Pa.

The appointment of *Benjamin S. Sampson* as manager of its Industrial Furnace & Oven Div. has been announced by the Claud S.

BURLING TEMPERATURE LIMIT SWITCHES

USE NO LIQUIDS . . . NO GASES



Literature on Request

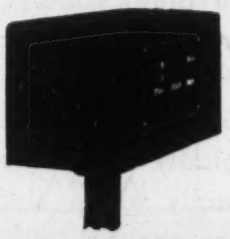
MODEL H
Approved by Factory Mutual Laboratories

Improved High Temperature Safety Switch. Available with switch normally closed for cutting off heat, stopping fan, closing valve—with switch normally open for lighting lamp or ringing bell—with single pole double throw switch . . . breaks heating circuit while closing alarm circuit.

- **Accurate, Rugged, Dependable**
- **Corrosion and heat resisting tube**
- **Dial Pointer for easy setting inside case**
- **Locking screw locks temperature setting.**
- **Terminal plate has large screw terminals**
- **Snap-action Micro-Switch eliminates contact troubles**
- **Range minus 100° to 1400° F. Adjustable range 200 degrees**
- **Dimensions—5⅛" x 1¾" x 3"**

MODEL V-I

For lower temperature range from 0-300°F. Available for minimum of —100° to maximum of 600°F. Usual adjustable range 50-150°, operating differential may be as small as ±¼ or as large as ±5°. Adjustable by screw and dial inside case. (Sizes 2¾" diameter × 4¼" high.)



MODEL D

Adjustable range 200-500°F. Temperature range 0-1400°F. For use where temperature must be changed to suit operating conditions. Turn outside knob to change temperature setting. (Sizes 5½ x 2¾ x 2¾".)

Instruments also Built to Specifications

Making Precision Controls for Over 12 Years

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The FIRST controlled-atmosphere electric furnace ever sold!

Sold in 1927, and retired as a museum piece after 20 years, "Old Number One" is still a competent high speed steel hardening furnace The features which C. I. Hayes Inc pioneered, later called "Certain Curtain," are still the basic essentials of THE MOST ECONOMICAL HEAT-TREATING, wherein the natural advantages of electric heat are combined with precision control of furnace atmosphere

—and one of its famous descendants

BAC-300M CONVEYOR FURNACE

BAC-300M operates at temperatures up to 2200°F, with inconel muffle, for sintering, hardening, and carbo-nitriding under the "Certain Case" method. Atmosphere may be hydrogen, dissociated ammonia, or combusted gas. Oil or water quench. Completely automatic, outstanding for economy of operation and low cost of product treated.

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Roto-Finish methods, materials, and equipment *mechanize* your finishing operations, putting them on a high-speed, smooth-flowing basis. Roto-Finish eliminates tedious, time-consuming manual procedures to save you money, materials, and manpower. Also, it improves results, maintains exacting quality standards, holds critical tolerance specifications uniformly and reduces rejects.

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***Windsor, Canada*—F. B. Stevens of Canada Limited**
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ORIGINAL ENGINEERED
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News of...

ENGINEERS
COMPANIES
SOCIETIES

Gordon Co. Mr. Sampson formerly served as district sales manager of the Stewart Furnace Div., Sunbeam Corp.

The election of *Henry P. Reid* to the newly created office of vice president-engineering, and the appointment of *Charles B. Baker* as assistant to the president, have been announced by the Universal Atlas Cement Co. Mr. Reid served as chief engineer of this United States Steel subsidiary; and Mr. Baker, secretary, general attorney and director of Universal, will continue to serve in these capacities in addition to his new assignment.

George E. Dresser, manager of Hardware-Automotive Sales for the Carborundum Co., is retiring after 42 years of service. He will be succeeded by *Charles W. Sprenger,* assistant manager of the same division.

The Yale & Towne Manufacturing Co. recently elected *Gilbert W. Chapman* president of the company. Mr. Chapman, formerly vice president in charge of finance, succeeds *Calvert Cary,* who resigned because of ill health.

The Elgin National Watch Co. has named Dr. *Martin H. Heerin* director of applied research for its Industrial Products Div. Dr. Heerin, for many years director of research for the Armour Research Foundation of the Illinois Institute of Technology, will make his headquarters in Aurora, Ill.

The Columbia Steel Co., a United States Steel subsidiary, has elected *O. L. Pringle* vice president in charge of sales. *Laurence S. Dahl* succeeds Mr. Pringle as vice president in charge of operations. And *H. S. Worthington* was named assistant to the vice president in charge of operations.

Dr. *Paul R. Trumpler* has been appointed professor of mechanical engineering at the Illinois Institute of Technology. He formerly served as engineer for the Centrifugal Engineering Dept. of the Clark Brothers Co.

The Babcock & Wilcox Co. has added three new members to the Chemical Laboratory staff of its Research & Development Dept. They are *Hayden Jones, Jr., Norman Phillips,* and *Earle Young, Jr.*

The appointment of *Edward R. Anderson* as vice president of the Kellogg Div. has been announced by the American Brake Shoe Co. Mr. Anderson will continue to serve as district sales manager of the Pacific District for the Kellogg Div., with headquarters in San Francisco, Calif.

John F. Miller has joined the Illinois Tool Works as manager of its Tool Div. Mr. Miller was formerly sales manager of the Machine Tool & Cutting Tool Div. of the Ex-Cell-O Corp.

The American Steel & Wire Co. has named *B. E. Pheneger* assistant to the vice president of operations, his headquarters to

WISE ECONOMY • WISE SELECTION of CUTTING FLUIDS • WISE ECONOMY

Learn about the WISE ECONOMY PLAN. Visit the D. A. Stuart booth No. 426 at the National Metal Congress & Exposition or write, wire or phone D. A. Stuart Oil Co., Ltd. for further information. (Telephone BIshop 7-7100.)

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Copper
Inconel
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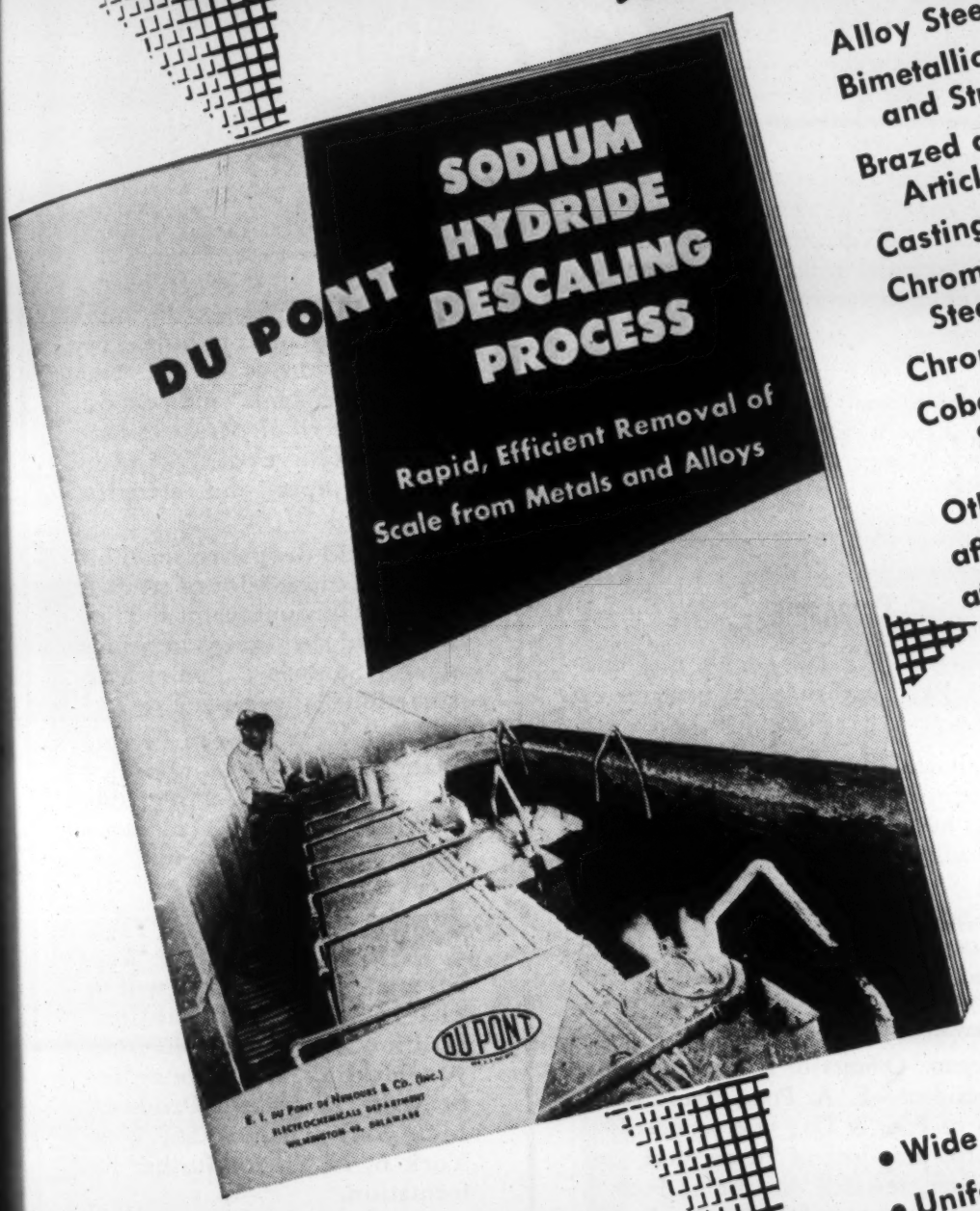
Other metals which are not affected by fused caustic at 700°F.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SODIUM HYDRIDE DESCALING PROCESS
Rapid, Efficient Removal of Scale from Metals and Alloys
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- Wide Application
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It can be used for surface finishing, lubrication control, removing discoloration, preparing surfaces for plating, finishing threaded sections, plus many other uses.

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BLAST CLEANS CHEAPER
with the right equipment
for every job

News of...

ENGINEERS COMPANIES SOCIETIES

be in Cleveland. *L. J. Westhaver* succeeds Mr. Pheneger as district manager of operations for the Duluth, Minn. branch of this United States Steel subsidiary.

The death of Dr. *Fritz J. Hansgirg,* chief chemical engineer of the American Electro Metal Corp., has been announced. Dr. Hansgirg was internationally known for his invention of manufacturing metallic magnesium.

Philip M. Guba died recently following an extended illness. Mr. Guba was manager of sales, Eastern area, for the Carnegie-Illinois Steel Corp.

Companies

The *Burrell Technical Supply Co.,* Pittsburgh 19, Pa., has changed its name to the *Burrell Corp.*

The formation of *Azed, Inc.* by *Poor & Co.,* Chicago, and the *Acme Steel Co.,* Riverdale, Ill., has been announced. The new company will engage in the research, manufacture and sale of products and processes for all phases of the application and secondary treatment of zinc surfaces. Azed offices are located at 80 E. Jackson Blvd., Chicago 4; the laboratories are maintained at Riverdale and Waukegan, Ill.; and the factory is at Waukegan. Officers of the new firm include: president—F. A. Poor, chairman of the board of Poor & Co.; vice presidents—C. J. Sharp, president of Acme Steel, and A. E. Chester, research director of Poor & Co.; vice president and treasurer—P. W. Moore, president of Poor & Co.; secretary—P. W. Moore, Jr.; and general manager—R. R. Jenkins.

The *Atlas Research Laboratories* were dedicated recently at Mertztown, Pa. as a memorial to the late Maximilliam F. Wirtz, founder of the *Atlas Mineral Products Co.*

Consolidation of operations of the Warco Press Div. and the Welder Div. in its Plant No. 2, located at Overland Ave., Warren, Ohio, has been announced by the *Federal Machine & Welder Co.* This consolidation involves vacating the plant formerly known as the *Warren City Manufacturing Co.,* Warren, which has been engaged in the manufacture of the Warco press line.

A new Process Engineering Dept. has been formed by the *Detrex Corp.,* Detroit 32, Mich., which will be headed by George W. Pew. Another innovation by Detrex is the establishment of a streamlined cleaning consultation service for providing customers with the kind and degree of cleaning de-

DON'T LET IT HAPPEN IN YOUR PLANT!

PICKLING fumes do more than irritate your nose. They carry tiny drops of acid high above the tank and deposit them on roof girders, overhead cranes, conveyors, window frames, pipes and electrical fixtures.

The acid drops are small but they can cause a lot of trouble. They eat through paint and into steel, and rust creeps in behind them. Someday, somewhere, something goes wrong!

Don't let it happen in your plant! Use Oakite Composition No. 38, the new pickling additive that traps the acid fumes before they leave the tank!

FREE The Oakite Technical Service Representative in your city will be glad to show how Oakite Composition No. 38 can hold down your pickling fumes. Phone him or write to Oakite Products, Inc., 32H Thames St., New York 6, N. Y., for further information.

ALSO ***ask about Oakite procedures for:***

Cleaning in tanks
Cleaning in machines
Electrocleaning
Pickling
Pre-paint treatment
Barrel cleaning
Burnishing
Paint stripping
Steam-gun cleaning
Rust prevention

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The constant UNIFORMITY of Mueller Brass Co. Red Tip Rod saves tools, grinding and "down-time". Brass Rod users throughout the United States and abroad know this and they continue to use it year after year. THEY ARE ACTUALLY PINNING MORE PROFIT TO THEIR COST SHEETS.

There isn't any mystery in the manufacture of FREE TURNING Brass Rod.

But, there are two intangibles that do produce quality Rod, and these are UNIFORMITY and "know-how".

During the past 32 years the Mueller Brass Co. has specialized in making FREE CUTTING Brass Rod, and during that time has acquired a certain "know-how" that cannot be expressed or measured. This "know-how", together with constant UNIFORMITY, are the only "secret" ingredients. The chemical composition, structure, temper and mechanical properties are so closely controlled that no perceptible variation in machinability is noted from rod to rod.

We are constantly producing Brass Rod that will meet any specification. If you want it for knurling, we make it — or for deep drilling, thread forming or for bending, expanding or flaring — or just an all-purpose, extra-fast, easy-cutting Rod, we make it. Our Technical Engineers and Laboratory are at your disposal any time.

Millions of pounds of brass rod are manufactured in our mills each month. Shipment can be made at once from our large factory stocks.

STREAMLINE PRODUCTS ®

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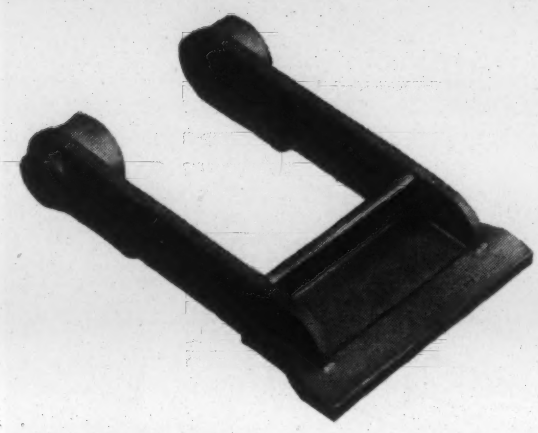
PORT HURON, MICHIGAN

an ideal part for

. . PRECISION INVESTMENT CASTING . .



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neatness
strength
heat treatable
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This steel casting is furnished to our customer ready for drilling, reaming and light finishing at a fraction of the cost of fabricating by any other method. A clear example of how Precision Investment Casting can save you money.

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Small precision castings of ferrous and non-ferrous alloys.

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News of...

ENGINEERS COMPANIES SOCIETIES

sired at lowest possible cost. T. W. Kearney, chief engineer in the Equipment Div., is in charge of this new service.

Kaiser Co., Inc., Oakland 12, Calif., has changed its name to the *Kaiser Steel Corp.*

A new plant for the production of sheet and plate magnesium is to be built in Detroit by the newly-formed *Wrought Magnesium Corp.,* a subsidiary of *Brooks & Perkins, Inc.,* Detroit. Production at the rate of 500,000 lb. per month will begin within a year. Officers of the new company, located at 2457 Woodward Ave., Detroit 1, include the following: president, Howard Perkins; vice president and treasurer, K. C. Reeves; and secretary, F. W. Seitz.

An expansion program to increase production in the Chemical Div. of the *Goodyear Tire & Rubber Co.,* Akron, Ohio, by 50% of its present capacity has been announced. Buildings and equipment installations are expected to be completed by Nov. 1, with production in full gear before the first of the year.

The *Panelyte Div.* of the *St. Regis Paper Co.,* New York 17, has acquired from *Time, Inc.,* a paper coating mill at Kalamazoo, Mich., which will be converted to the production of laminated plastics. Operation of the plant is expected by January 1950, or shortly thereafter. James E. Kussman has been named manager of the new plant.

Formation of a Production Parts Div. has been announced by *Scully-Jones & Co.,* Chicago 8. J. Dudley Lockrem, vice president, will head the new division.

The *Amperex Electronic Corp.,* Brooklyn, N. Y., has appointed the *S. Sterling Co.,* Detroit, as its representative in the Michigan area.

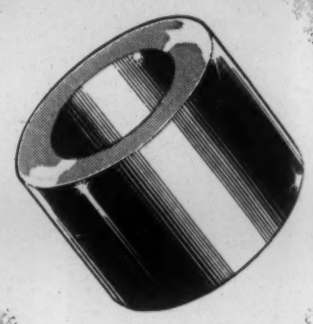
Excavation for the *General Motors Corp.'s* Technical Center has begun at Mound & Twelve-Mile Rds., Detroit, Mich. The work was started on the Engineering Group buildings, which are expected to be ready for occupancy by the late summer of 1950.

The *E. W. Bliss Co.,* Toledo, Ohio, has appointed the *Wegner Machinery Corp.,* 35-41 Eleventh St., Long Island City, N. Y., as its authorized service dealer in metropolitan New York, Connecticut and New Jersey.

Societies

The *Pressed Metal Institute* recently elected officers for the coming year. They are as follows: president—Woodard G. Jeschke, president, Res Manufacturing Co.; vice president—Howard Wolf, assistant to the

WORKS WHERE OTHERS WON'T



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ALLOY STEEL CASTINGS *for*

- LONGER WEAR
- HIGHEST QUALITY

CALUMET

SERVICE *for* . . . . . .

- PROMPT DELIVERY
- DEPENDABLE EMERGENCY PRODUCTION

Our operations assure you of efficient service on every type of order

CALUMETAL

CALUMET STEEL CASTINGS CORP.
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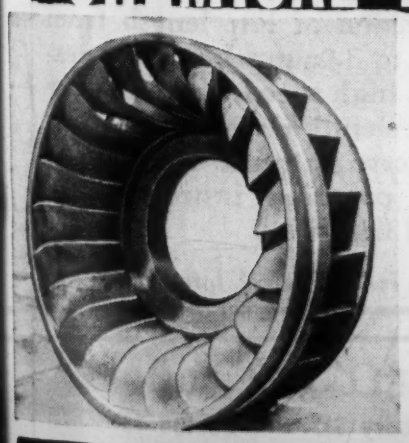
"Controlled"

Bronzes

for ENGINEERING and CHEMICAL PURPOSES



By "controlled", we mean that every step in alloying, molding, pouring & cooling is under *careful supervision* of trained men *in our own plant* . . . So, if you require non-ferrous castings (large or small) to meet any of the following conditions, you are safe in bringing your problems to us: Corrosion Resistance; Strength in Tension and Compression; Hardness and Toughness; Pressure Tightness; Erosion Resistance; Frictional Wear Resistance or Fatigue Resistance.
Would you like a copy of our famous 46 page flexible-bound Reference Book entitled, *"Bronze Casting Alloys"*? If so, write us on your business letterhead.

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Micro-structure of a nitrided case produced by an improved nitriding process* which produces a surface with a minimum of "white layer".

Micro-structure of a normal nitrided case showing the white surface layer which generally must be removed by grinding or lapping.

AND REDUCES FINISHING COSTS OF THESE

A new special nitriding procedure, developed by Nitralloy, substantially reduces—and in many cases eliminates—grinding, or other finishing costs. The new method produces a surface with a minimum of white layer, a surface ideal for wear resistance, a surface which may require no finishing whatever, and the hardest metallic surface known.

This development adds an extra value to Nitrided Nitralloy, a value that helps cut costs when you want steel parts virtually undistorted in hardening, with extreme case hardness, high core strength, excellent resistance to wear, fatigue and certain kinds of corrosion.

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Atlas Steels Limited.....Welland, Ont.
The Babcock & Wilcox Tube Co.....Beaver Falls, Pa.
Bethlehem Steel Company.....Bethlehem, Pa.
Copperweld Steel Company.....Warren, Ohio
Firth-Sterling Steel Co.....McKeesport, Pa.
Grede Foundries, Inc. (steel castings).....Milwaukee, Wis.
Rotary Electric Steel Co.....Detroit, Mich.
Vanadium Alloys Steel Company.....Pittsburgh, Pa.

Joseph T. Ryerson & Son, Inc.....Chicago, Ill.
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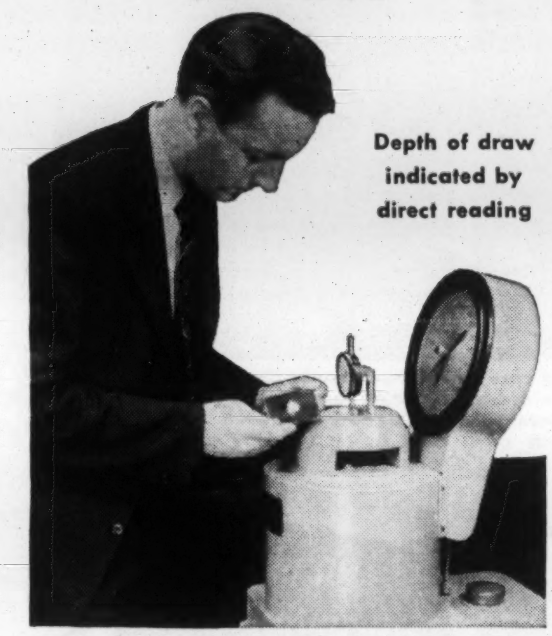
lets you determine the DRAWING QUALITY of SHEET METAL

***Use it for receiving, inspection and quality* CONTROL**



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TESTING MACHINE

Model PA-2

THOUSANDS of dollars of scrap material can often be saved by making this simple cup test. A flick of a switch operates machine. Speed of piston travel is adjustable within a wide range by simple dial setting. Load is applied automatically and uniformly to grip the specimen, followed immediately by penetrator to form cup. Pressure is accurately shown on large gauge with maximum indicating hand; depth of draw shown on depth indicator. Hydraulically operated. Model PA-2 has 15,000 lb. capacity for stock up to 1/8" thick; Model PA-3 has 30,000 lb. capacity for stock up to 1/4" thick. Write for literature.

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News of...

ENGINEERS
COMPANIES
SOCIETIES

president, Mullins Manufacturing Co.; and secretary-treasurer—Joseph J. Boehm, head, Boehm Pressed Steel Co.

Dr. Edgar C. Bain, vice president of the Carnegie-Illinois Steel Co., will receive the 1949 Gold Medal of the *American Society for Metals* at the Society's annual meeting this month. The Medal will be awarded to Dr. Bain in recognition of his great versatility in applying science to the metal industry.

Members of the *Alloy Casting Institute* elected the following officers at their recent annual meeting: president—Harry A. Cooper, president, Cooper Alloy Foundry Co.; vice president—R. W. deWeese, Electric Steel Foundry Co.; and executive secretary and treasurer—E. A. Schoefer, Alloy Casting Institute.

Benjamin F. Fairless, president of the United States Steel Corp., was presented with an honorary degree of Doctor of Science in Business Administration Honoris Causa by *Bryant College* at its recent Commencement exercises.

Arthur E. Focke, research metallurgist for the Diamond Chain Co., will take office as president of the *American Society for Metals* at the Society's annual meeting the week of Oct. 17th. The new vice president of the Society will be Dr. Walter E. Jominy, staff engineer of the Chrysler Corp.

T. W. Lippert has been appointed manager of publications of the *American Institute of Mining & Metallurgical Engineers.*

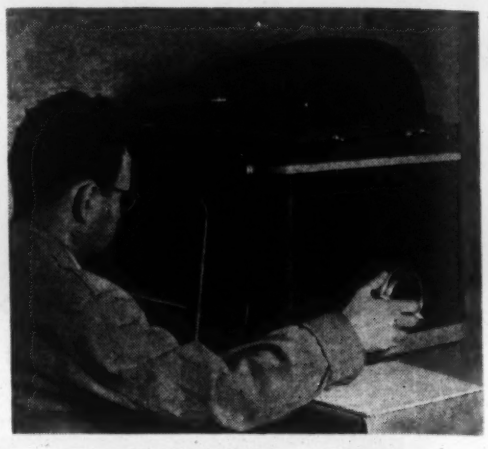
Dr. Edward F. Degering, professor of chemistry and director of industrial research projects at Purdue University, has been named assistant chairman of chemistry and chemical engineering research at the *Armour Research Foundation* of the *Illinois Institute of Technology.*

Alexander H. d'Arcambal, vice president and consulting metallurgist of Pratt & Whitney, Div. of Niles-Bement-Pond Co., had conferred upon him the degree of Metallurgical Engineer by his Alma Mater, the *University of Michigan.*

The *American Cyanamid Co.* announces the renewal of 15 scholarships for the academic year 1949-50, chiefly in the fields of chemistry and chemical engineering. $1500 will be awarded to graduate students in their last year of pre-doctoral study, and $3000 to recipients of post doctoral scholarships.

Three Purdue University seniors have been named recipients of *William Loren Batt Awards,* established by Mr. Batt, president of SKF Industries, Inc., to stimulate inventiveness and ingenuity among the University's undergraduate and graduate school engineering students. The winners were John B. Hughes, James E. Ballinger, and L. Glenn Whitesell.

"Yes, you can vary the slit width and length!"



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The practical spectrographer can now adjust his microphotometer slit width to take advantage of the increased resolution obtained by the use of narrower spectrographic slits. With the JACO instrument, you can measure precisely and accurately the density of lines produced by a spectrographic slit as narrow as 10 microns wide and 3mm. long. You can also adjust the length of the microphotometer slit to permit the selection of line length from 0.5mm. to 3.0mm. Improved resolution, high speed, precise linear measurement, and wide density range serve to make this a high quality precision instrument of unusual flexibility.

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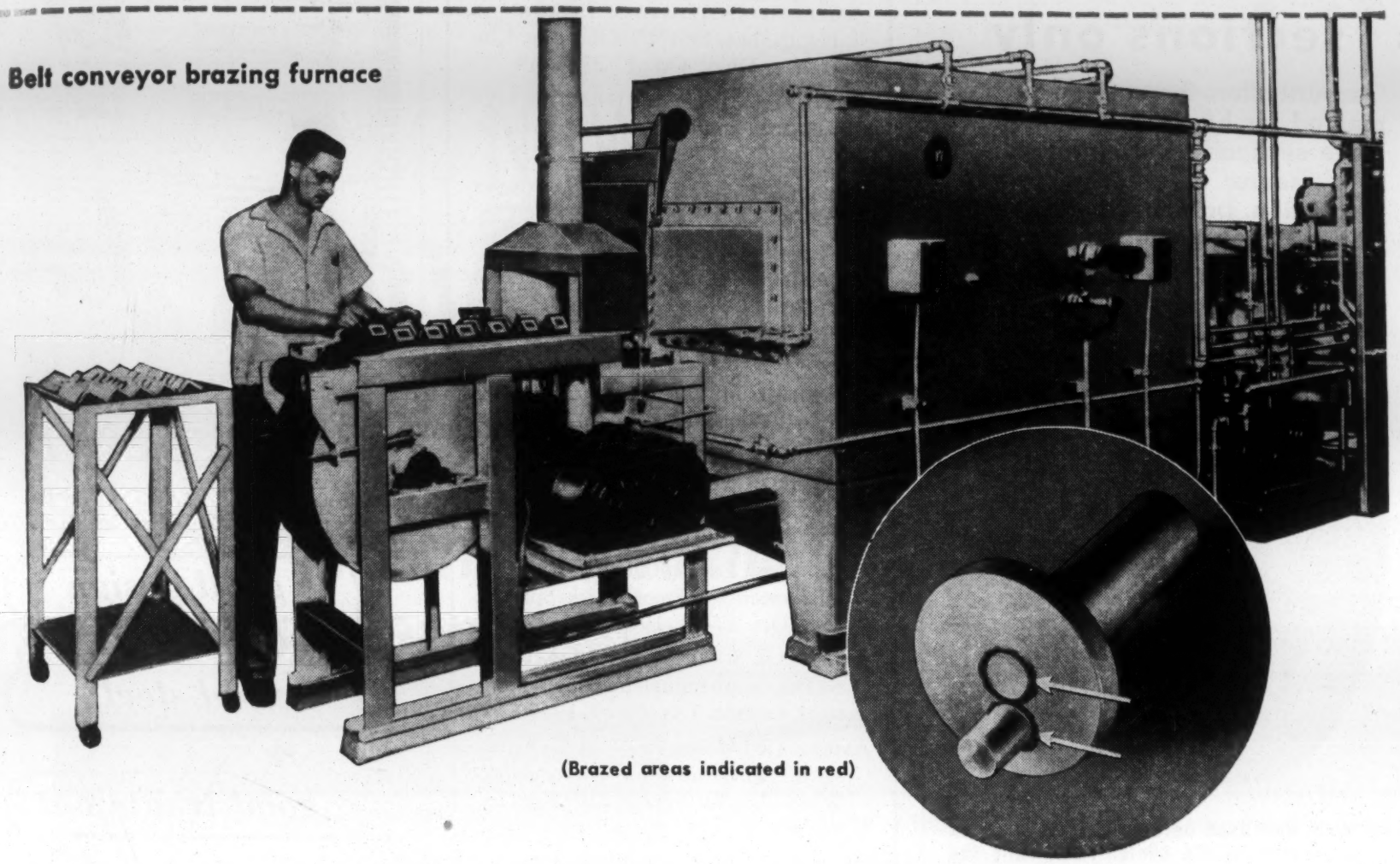

Belt conveyor brazing furnace

(Brazed areas indicated in red)

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every 8 working hours with Westinghouse Brazing

Four cents per unit! $1,120 every eight hours. That's what one manufacturer saved when he switched from machining to Westinghouse brazing. With production of 3,500 units per hour, each furnace produced these startling savings.

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For either gas-fired or electric operation, Westinghouse can make thorough, impartial recommendations for the type of equipment needed to handle your heat-treating problem most economically. Get all the facts today. Call your nearest Westinghouse office or write Westinghouse Electric Corporation, 186 Mercer Street, Meadville, Pennsylvania. J-10347

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hardens desired sections only

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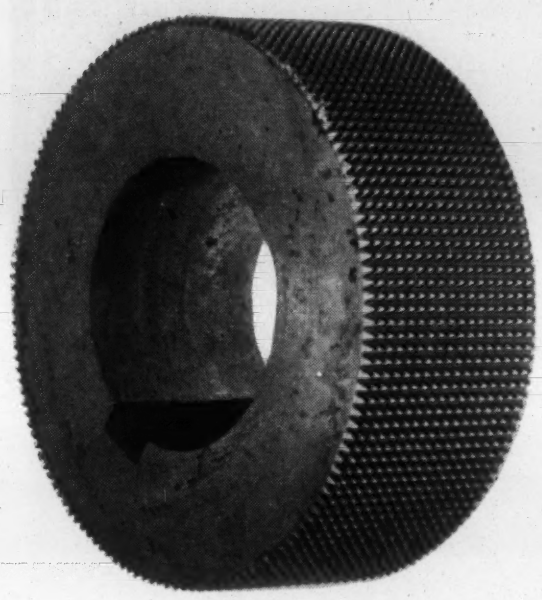

Carburit was used here to harden only the inner surface of the center hole while the remainder of the work had to remain soft. Depth of case .025" obtained in 25 minutes —hardness 64 Rockwell C.

1. **Easiest method for section hardening—apply paste only to parts of work that require case hardening.**
2. **No special equipment needed—not even a furnace. For the first time case hardening is possible in an open forge. (Of course, CARBURIT can be used in a furnace and with more precise results than in a forge).**
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Meetings and Expositions

NATIONAL METAL CONGRESS AND EXPOSITION. Cleveland, Ohio. Oct. 17-21, 1949.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Mid-West meeting. Cincinnati, Ohio. Oct. 17-23, 1949.

SOCIETY FOR NON-DESTRUCTIVE TESTING, annual meeting. Cleveland, Ohio. Oct. 19-20, 1949.

AMERICAN GEAR MANUFACTURERS ASSOCIATION, annual meeting. Chicago, Ill. Oct. 24-26, 1949.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Fuels Div. conference. French Lick Springs, Ind. Oct. 26-27, 1949.

NATIONAL METAL TRADES ASSOCIATION, annual convention. Chicago, Ill. Oct. 26-28, 1949.

GRAY IRON FOUNDERS' SOCIETY, annual meeting. Chicago, Ill. Oct. 27-28, 1949.

PORCELAIN ENAMEL INSTITUTE, annual meeting. French Lick Springs, Ind. Oct. 27-28, 1949.

AMERICAN SOCIETY OF TOOL ENGINEERS, semi-annual meeting. Montreal, Canada. Oct. 27-29, 1949.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual convention. White Sulphur Springs, W. Va. Oct. 31-Nov. 3, 1949.

SOCIETY OF AUTOMOTIVE ENGINEERS, diesel engine meeting. St. Louis, Mo. Nov. 1-2, 1949.

PACIFIC CHEMICAL EXPOSITION. San Francisco, Calif. Nov. 1-5, 1949.

AMERICAN SOCIETY OF BODY ENGINEERS, annual meeting. Detroit, Mich. Nov. 2-4, 1949.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting. Washington, D. C. Nov. 2-4, 1949.

SOCIETY OF AUTOMOTIVE ENGINEERS, fuels and lubricants meeting. St. Louis, Mo. Nov. 3-4, 1949.

MEEHANITE METAL INSTITUTE, annual meeting. Cleveland, Ohio. Nov. 3-5, 1949.

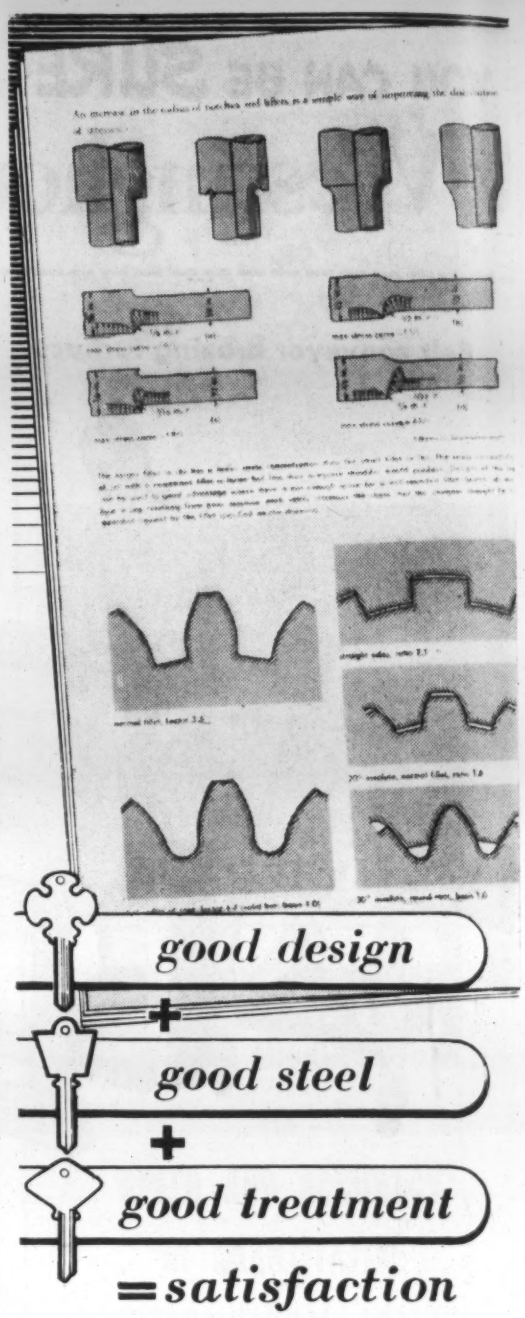
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting. Pittsburgh, Pa. Nov. 7-10, 1949.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Industrial Minerals Div. Tampa, Fla. Nov. 9-11, 1949.

NATIONAL FOUNDRY ASSOCIATION, annual meeting. New York, N. Y. Nov. 10-11, 1949.

ALL-INDUSTRY REFRIGERATION & AIR CONDITIONING EXPOSITION. Atlantic City, N. J. Nov. 14-18, 1949.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION, annual meeting. Atlantic City, N. J. Nov. 14-18, 1949.



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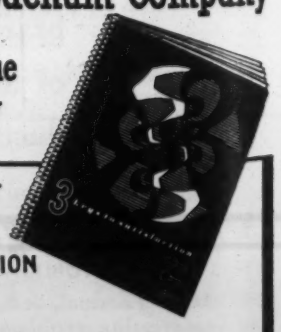

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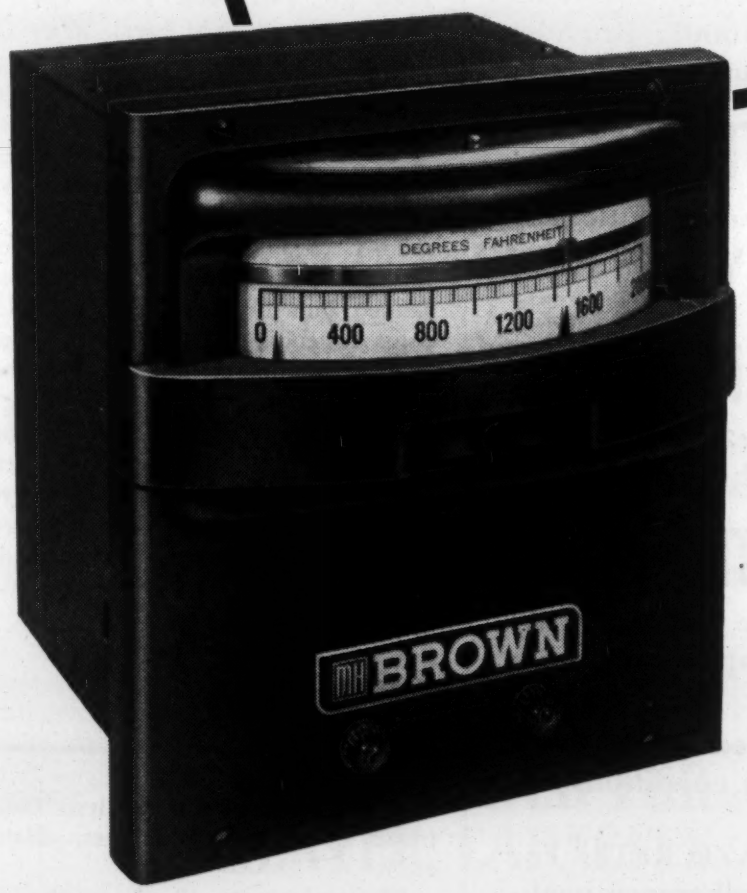

THE NEWS is out about this latest addition to the Brown line of temperature controllers . . . hundreds of metallurgists have been told the full story . . . and reports of high praise are coming in from the field! No wonder the reception is so enthusiastic . . . here are the more important reasons!

- √ Corrective action is instantaneous . . . provides *continuous non-cyclic control.*
- √ Separately enclosed high-resistance galvanometer, more sensitive and powerful, reduces maintenance.
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- √ Case is universal . . . for flush or surface mounting.

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Branch offices in 73 principal cities of the United States, Canada and throughout the world

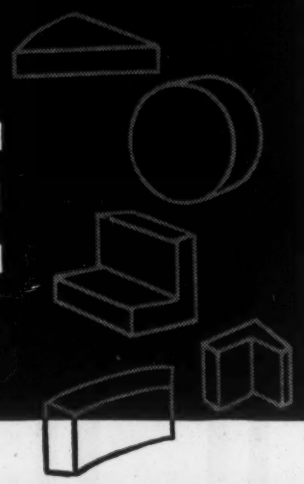
MINNEAPOLIS Honeywell — *Advanced Instrumentation* FOR METAL PROCESSING — BROWN INSTRUMENTS

CAST SPECIAL SHAPES QUICKLY . . . EASILY

. . . with these

FIRECRETE

Castable Refractories



Check the job to be done and you will find a Firecrete* product that will do it well. For special refractory shapes or linings it's simply mix and cast. The new shape or lining air-hardens and is ready for service within 24 hours. Other advantages include—no drying shrinkage, negligible firing shrinkage, high resistance to spalling.

For use up to **3000F — 3X FIRECRETE**

This new member of the Firecrete family effectively withstands soaking temperatures up to a full 3000F. Provides savings through longer life and reduced shutdowns.

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A high heat-duty refractory composed of an exceptionally heat-resistant base. Specially developed for service between 2400F and 2800F.

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The most generally applicable type of Firecrete. Finely ground, permitting casting of shapes or linings as thin as 1½".

For use up to **2400F — L-W FIRECRETE**

A lightweight insulating refractory concrete with unusually low thermal conductivity, low heat storage capacity and high resistance to spalling.

The above Firecrete materials can be used in combination where varying temperature and service conditions are encountered.

For patching and gunning, use 3X BLAZECRETE. For temperatures to 3000F. It has exceptional adherence qualities, can be flipped into place with a trowel without ramming or tamping.

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BOOK REVIEWS

Metallographic Practice

PRINCIPLES OF METALLOGRAPHIC LABORATORY PRACTICE — 3RD EDITION. *By George L. Kehl. Published by McGraw-Hill Book Co., Inc., New York, 1949. Cloth, 6¼ by 9¼ in., 520 pages. Price $5.50.*

This comprehensive text presents the fundamental principles of metallographic laboratory practice, including information on latest techniques and new equipment. In this edition, test procedures have been revised to conform with the latest specifications established by various technical societies, and tabular data have been expanded and brought up-to-date. The 88-page Appendix alone contains a wealth of tabular data on etching reagents, hardness conversion, temperature conversion, etc.

An indication of the scope of the book can be found in the chapter headings: Preparation of Specimens for Microscopic Examination; Etching of Specimens for Microscopic Examination; Metallurgical Microscopes and Photomicrography; The Principles of Photography; Macroscopic Examination of Metals; Hardness Testing; Special Metallurgical Tests (including methods for determining austenitic grain size, Jominy test, defect analysis, etc.); The Principles of Pyrometry and Pyrometric Practice; and Thermal Analysis (including phase transformation studies, dilatometry, etc.).

The references listed at the end of each chapter provide an excellent bibliography, especially for subjects which could not possibly be covered adequately in a text of this kind, *e.g.* color photomicrography.

Alloys Systems

ALLOY SYSTEMS. *By James Osborn Lord. Published by Pitman Publishing Corp., New York, 1949. Cloth, 6 by 9¼ in., 380 pages. Price $5.00.*

Intended as an introductory college text on metallography and physical metallurgy, this book started as a series of lectures designed for easy assimilation and, as a

for superior corrosion resistance

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. . . the Elgin developed alloy that has demonstrated such remarkable performance as a watch main spring material in famous Elgin watches. Now available to industry in strips and rounds, ELGILOY withstands 1072 hours of 20% salt spray at 95° F. without rusting and resists attack by both organic and inorganic acids.

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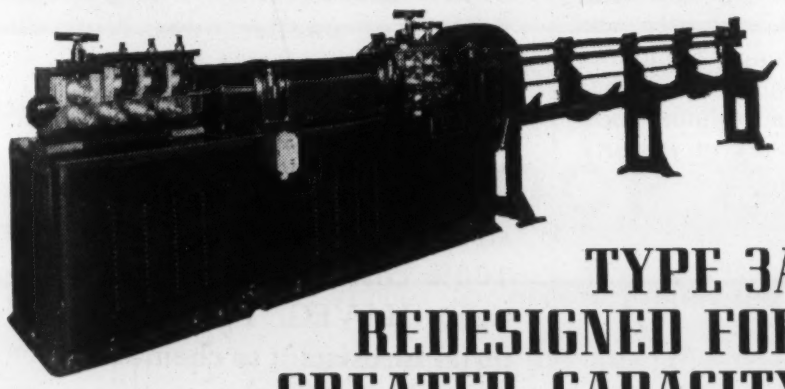
MAKERS OF DOT FASTENERS

SHUSTER

WIRE STRAIGHTENER



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Please send me full particulars about Luster-on bright dip for zinc surfaces. I am (am not) sending sample part for free dip. No obligation, of course.

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Book Reviews

(continued)

result, is written in readable style.

The author's primary purpose is to develop logically and understandably the concepts of phase rule, binary phase diagrams, thermochemical equilibrium, mass-action equations, and atomic structure of crystals. The technological applications of the principles developed in this presentation are covered in extensive discussions of selected commercial alloy systems, including carbon, nickel, manganese, chromium, molybdenum, tungsten and high-speed steels, and many nonferrous alloy systems.

Additional material on the manufacture of iron and steel, defects and impurities in steel, and physical and mechanical properties is included with a view toward increasing the general usefulness of the text.

SAE Specifications

1949 SAE HANDBOOK. *Published by Society of Automotive Engineers, Inc., New York, 1949. Cloth, 933 pages. Price $10.00 ($5.00 to members).*

This annual publication has undergone the most extensive series of revisions in its 39 years. Thirty-one new automotive standards and specifications have been added, and nine standards have been cancelled.

An important contribution is in the field of materials specifications. Standardized for the first time is a series of alloy steels that may be brought to hardenability specifications. Known as H-Steels, these steels are designated by a number indicative of the chemical compositions, according to usual SAE practice, followed by the letter H.

Among new standards are the first to be developed by the SAE Construction and Industrial Machinery Technical Committee on yardage ratings; and standards for body moldings and fasteners, and cylinder locks and keys resulting from work of the SAE Body Engineering Committee.

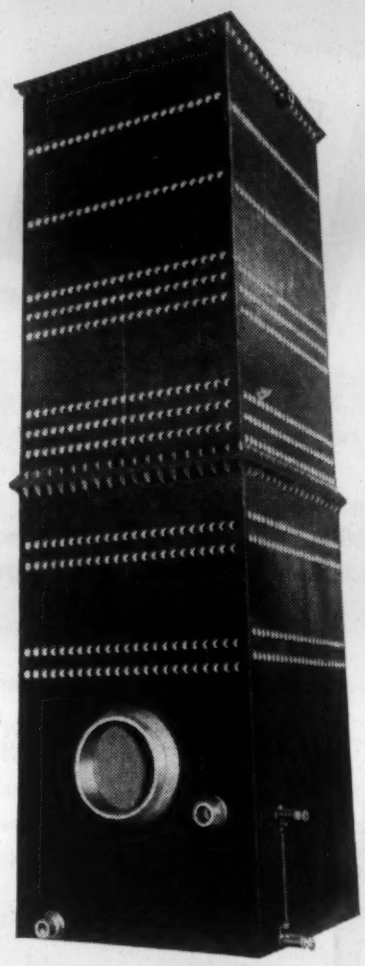
Heating by Induction

INDUCTION HEATING. *By N. R. Stansel. Published by McGraw Hill Book Co., Inc., New York, 1949. Cloth, 6¼ by 9¼ in., 212 pages. Price $3.50.*

The author's purpose here is to present the electrical and thermal principles of the use of eddy currents for heating service and to show how these principles are applied in practice. Extensive supporting data in the form of tables and graphs are included in the text.

The relationships of electrical, magnetic and thermal properties of conductive materials, of frequency, and of the dimensions and shapes of the body to be heated are discussed. References are listed in which may be found derivations of equations used. The author emphasizes the importance of the correct design of the primary coil,

a TOWER of strength



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Because HAVEG is so strong . . . so light in weight . . . it can cut the cost of huge towers like this. Used in handling corrosive acids, this cooler-absorber tower replaced a battery of smaller ones. Now efficiency of the entire operation is increased, and equipment costs are reduced.

If you need a material with high strength, toughness, durability plus 100% corrosion resistance, investigate HAVEG. This molded material is resistant to chemical action *throughout its entire mass*—not just on the surface. Large, structurally-strong equipment can be molded in one piece, at low cost, and delivered in from 1 to 8 weeks.

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Silicon Bronze Proves BETTER and CHEAPER!

Silicon bronze was used in casting this pump casing because of its high strength, its excellent resistance to corrosion, and its price advantage over high tin bronzes.

The casing, weighing over 100 pounds, is cast by Thomas Paulsen and Son, Inc., Brooklyn, New York, for the Eaton Chemical Division of the American Chemical Company.

Practical experience proves it . . . silicon bronze does many casting jobs better and cheaper . . . with a smoother finish. It handles well in the foundry . . . is readily castable with a minimum of smoking.

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Federated's complete line of non-ferrous metals includes copper base alloys, aluminum and magnesium alloys, brazing metals, solders, die casting alloys and fabricated lead products.

Check with your nearby Federated office for further information. Federated's metallurgical experts will be happy to help on silicon bronze or any foundry problem. Sales offices in 25 cities across the nation.

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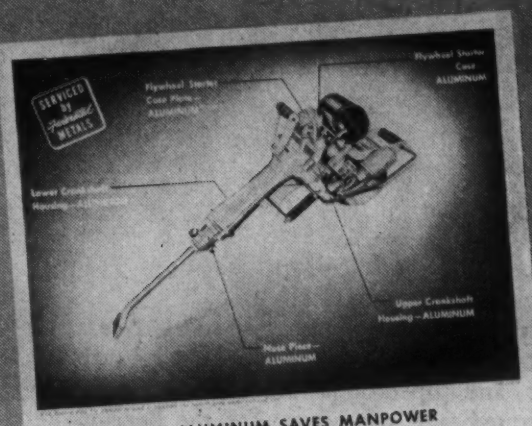
SHOO PROBLEM!

Federated METALS

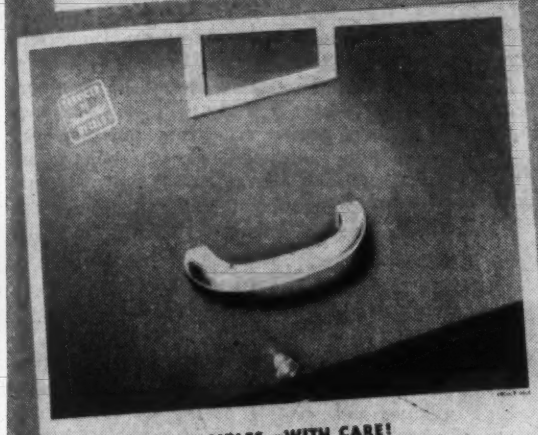
Division of American Smelting and Refining Company, 120 Broadway, New York 5, N. Y.



HOW ALUMINUM SAVES MANPOWER

Federated METALS

Division of American Smelting and Refining Company, 120 Broadway, New York 5, N. Y.



HANDLES—WITH CARE!

Casting aluminum drawer handles for file cabinets is a ticklish job. For its success on upstate New York foundryman needed an alloy with special properties of strength and ductility.

The foundry sought Federated's help. "We cannot recommend an existing alloy that will successfully fill the specifications" was the verdict of Federated's metallurgists. *BUT* they went further. They studied, made many tests, and finally produced a new alloy that did the job and did it right.

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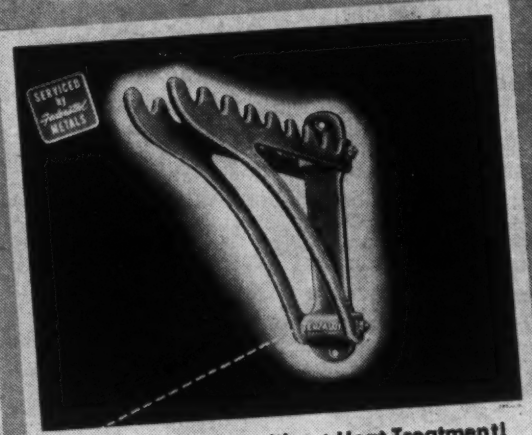

For High Strength without Heat Treatment!

This aluminum casting of a tool rack for shovels, lawn rakes and other heavy garden equipment, The Master Manufacturing Company of San Jose, California, chose for the fabrication at the product because of its great strength as cast, without the necessity of heat treatment. Tensile tensile strengths average 30,000 psi as cast, and 33,000 psi with 10-14 days aging at room temperature.

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Book Reviews

(continued)

inductor, or work coil in induction heating apparatus.

Although much of the material is fundamental in nature, induction heating equipment and operations are described and illustrated, and procedures for the development of new uses of this heating method are indicated.

Plastics Data

1949 MODERN PLASTICS ENCYCLOPEDIA. *Published by Breskin Publications, New York, 1949. Cloth, 1370 pages. Price $5.00.*

Designed as a working guide to all phases of plastics planning for companies using or contemplating use of plastics products or components, the latest edition of this standard reference book also covers technical advances made in the plastics industry during the last year.

The book includes a 200-page "Plastics in Use" section, which analyzes more than 1000 successful applications of plastics in 27 basic industrial fields, ranging from building materials to toys and novelties. Other sections of the book provide detailed information on all types of plastic materials, including coatings, film, sheeting, fibers, fabrics, laminates and resin-wood products, with special emphasis on their physical and chemical properties and their suitability for specific uses. Plastics designing, selection of raw materials, and molding and manufacturing techniques are covered in detail.

An additional feature is a 132-page "Buyers' Guide," covering plastics materials, equipment, machinery, supplies, and fabricating, molding and finishing services.

Other New Books

MACHINING OF METAL. *By Robert E. Smith. Published by McKnight & McKnight, Bloomington, Ill., 1949. Cloth, 8 x 10½ in., 224 pages. Price $3.50.* Describes modern machines used in working with metal, and gives step-by-step instruction for correct and safe operation of each of them.

PROCEEDINGS, FIFTH ANNUAL MEETING, METAL POWDER ASSOCIATION. *Published by Metal Powder Assn., New York 17, 1949. Paper, 6 x 9 in., 115 pages. Price $3.00.* Seven papers delivered at the meeting held in Chicago, Apr. 5-6, 1949, are contained in this booklet. Illustrations and complete discussions are included.

WHO'S WHO IN PLASTICS. *Published by Society of the Plastics Industry, Inc., New York, 1949. Plastic-coated, 6¼ by 9¼ in., 244 pages. Price $5.50 ($4.50 for SPI members).* Lists background and affiliations of 2989 individuals in the plastics industry, and location, key officers, and principal products and manufacturing methods of companies in the field. Serves as index for executives, engineers, designers, buyers and salesmen.

METALS AND ALLOYS—5TH EDITION. *Published by Louis Cassier Co., Ltd., London, England, 1949. Cloth, 5½ by 8½ in., 214 pages. Price 15/-.* Complete revision of 1941 edition. Lists 4600 compositions of nonferrous alloys containing not more than 50% iron.

CONSTRUCTIVE USES OF ATOMIC ENERGY. *Edited by S. C. Rothmann. Published by Harper & Brothers, New York, 1949. Cloth, 5½ by 8¼ in., 258 pages. Price $3.00.* Contains 14 articles on peaceful potentialities of atomic energy by scientists among the leaders in atomic research in many fields. Applications in industrial power, chemistry, metallurgy, aviation, ceramics, soil-fertilizer research, and biological, pharmaceutical and medical research are discussed.

CORROSION OF IRON AND STEEL BY INDUSTRIAL WATERS AND ITS PREVENTION. *Special Report No. 41 published by The Iron and Steel Institute, London, 1949. Cloth, 5¼ by 8½ in., 56 pages. Price 5/-.* Covers causes, occurrence and prevention of corrosion from industrial waters, including introductory section on general theory and mechanism of corrosion. Contains list of 99 references to papers in the English language.

STRUCTURAL DESIGN IN METALS. *By Clifford D. Williams and Ernest C. Harris. Published by Ronald Press Co., New York, 1949. Cloth, 6¼ by 9¼ in., 596 pages. Price $6.50.* Written as comprehensive college text. Emphasizes structural design of details rather than complete structures. Both welding and riveting details are covered, and use of aluminum alloys as well as steel is treated.

ATLAS OF ISOTHERMAL TRANSFORMATION DIAGRAMS. *Special Report No. 40, published by The Iron and Steel Institute, London, 1949. Cloth, 8¼ by 11 in., 63 pages. Price 25/-.* Compilation of "S" curves for 24 British Standards Institution En steels. Data on previous treatment, hardness of transformation products obtained at various temperatures, photomicrographs and general comments for each steel are included.

PRINCIPLES OF MAGNAFLUX—3RD EDITION. *By F. B. Doane and C. E. Betz. Published by Magnaflux Corp., Chicago, 1949. Cloth, 388 pages, 170 illustrations. Price $5.00.* Describes basic electrical and magnetic principles involved and methods, materials and equipment used in magnetic particle inspection. Written for supervisory personnel, inspection heads and Magnaflux operators.

WELDING METALLURGY—2ND EDITION. *By O. H. Henry and G. E. Claussen. Revised by G. E. Linnert. Published by American Welding Society, New York, 1949. Cloth, 5¼ by 7¾ in., 505 pages. Price $2.50.* Covers fundamentals of metallurgy, welding metallurgy of specific materials, and effect of different elements. New information on recent materials and processes presented. Includes short bibliographies and 203 illustrations.

PROCEEDINGS OF 21ST ANNUAL MEETING OF THE LEAD INDUSTRIES ASSOCIATION. *Published by Lead Industries Assoc., New York, 1949. Paper, 6 by 9 in., 69 pages. Price $2.00.* Transcript of meetings held April 8-9, 1949.

PROCEEDINGS OF 35TH ANNUAL CONVENTION OF THE AMERICAN ELECTROPLATERS' SOCIETY. *Published by American Electroplaters' Society, Jenkintown, Pa., 1949. Cloth, 6 by 9¼ in., 312 pages. Price $5.00.* Transcript of technical sessions held June 27 to July 1, 1948.

OXYACETYLENE WELDING AND CUTTING—A COURSE OF INSTRUCTION—4TH EDITION. *By Stuart Plumley. Revised by T. B. Jefferson. Published by McGraw-Hill Book Co., Inc., New York, 1949. Cloth, 8¼ by 11¼ in., 356 pages. Price $6.50.* Designed as concise easy-to-understand course in oxyacetylene welding and cutting technique. Covers all types of welding and cutting work, with stress on newer techniques. Chapters on job-shop operation and management included for welding-shop owners.

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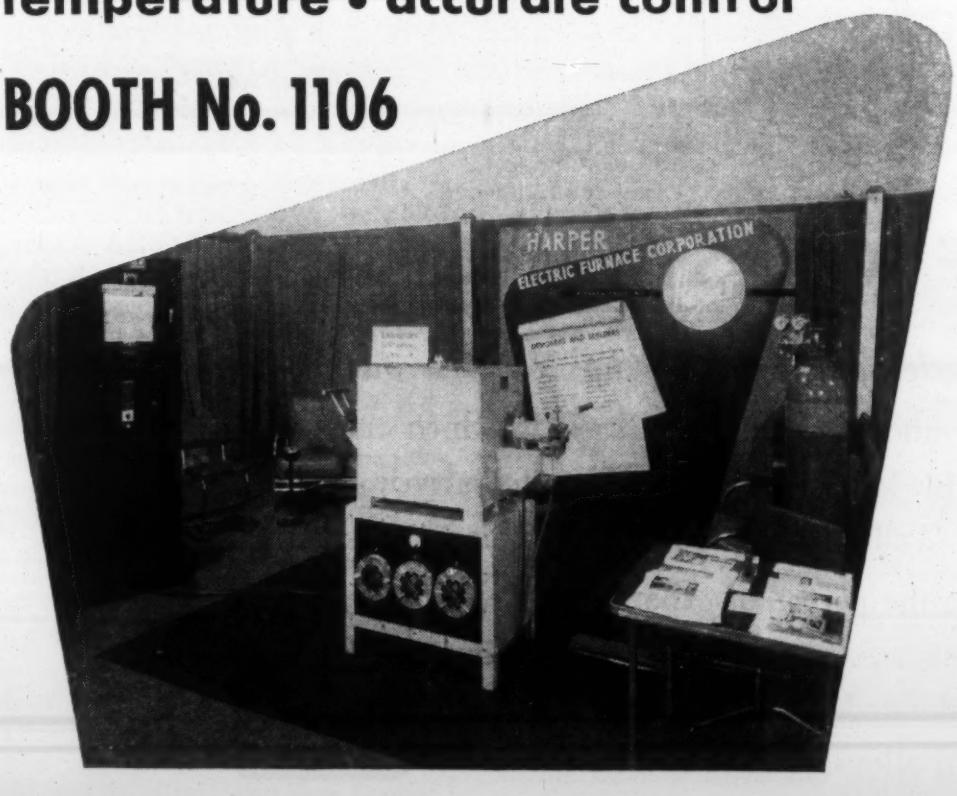

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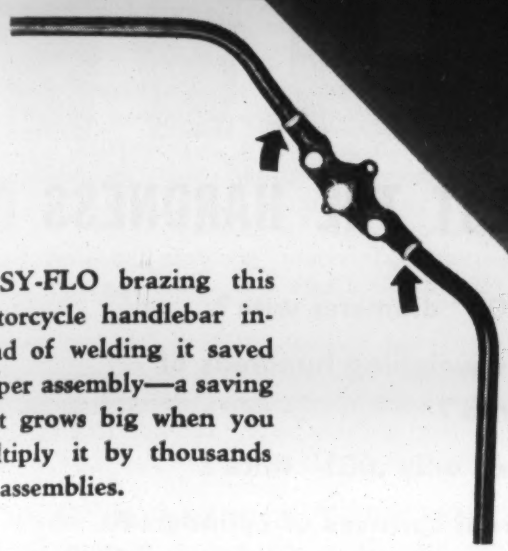
A simple way to DO something about ECONOMY-IN-PRODUCTION

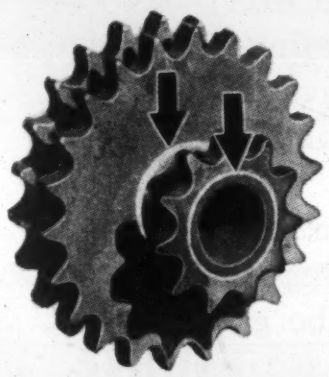


EASY-FLO brazing this motorcycle handlebar instead of welding it saved 8¢ per assembly—a saving that grows big when you multiply it by thousands of assemblies.

Everybody is talking about economy-in-production. It's the keynote of the Metal Show to be held in Cleveland, October 17 to 21. But what counts most is *doing* something about it. In some cases, of course, that's not always so easy. There are, however, hundreds of fabricating operations where economy could be quickly effected by using methods which can be readily adopted.

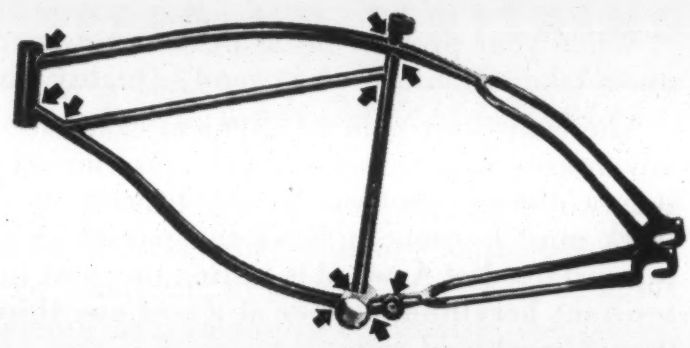
One such method that offers quick results is *EASY-FLO* and *SIL-FOS low-temperature silver alloy brazing.* It has boosted production and cut costs on thousands of products. Illustrated are a few typical tried and proved ways to

BRAZE AND SAVE WITH EASY-FLO AND SIL-FOS



Big savings are possible on many parts now machined from the solid by changing to a built-up assembly brazed with EASY-FLO. The triple-sprocket above and hose nozzle adjusting part at right are good examples.

Plenty can be saved on many parts now cast, by changing to EASY-FLO or SIL-FOS brazed construction. The gas burner (above), once an iron casting, is now made of tubular steel members EASY-FLO brazed at about 50% lower cost.



Finishing is another operation on which EASY-FLO and SIL-FOS brazing can save plenty. The maker of the EASY-FLO brazed bike frame (above) says—"This method produces joints of great strength which are absolutely clean—free from excess brazing metal—making possible a better looking enamel finish."

Attaching spuds to many types of equipment can be done faster and cheaper with EASY-FLO and SIL-FOS brazing. Using EASY-FLO and induction heating, instead of soft soldering by hand, reduced cost on the automobile oil pan spud (left) from $11.00 to $4.50 per hundred.

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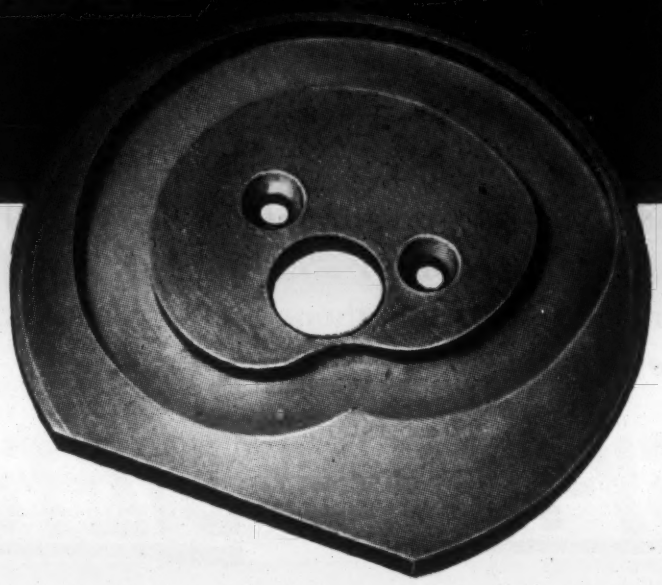

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Visit our exhibit, No. 2411, at the 31st Annual National Metal Exposition and Congress in Cleveland the week of October 17, 1949.

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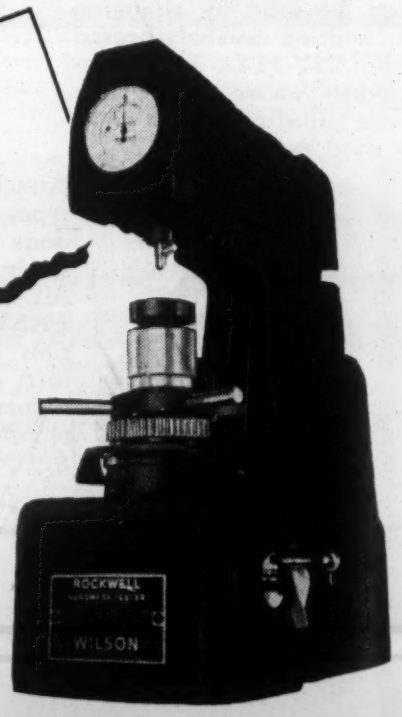

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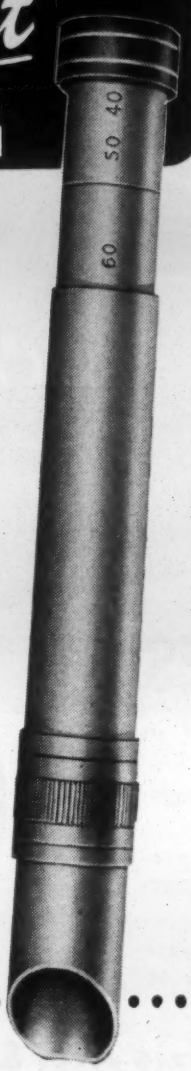

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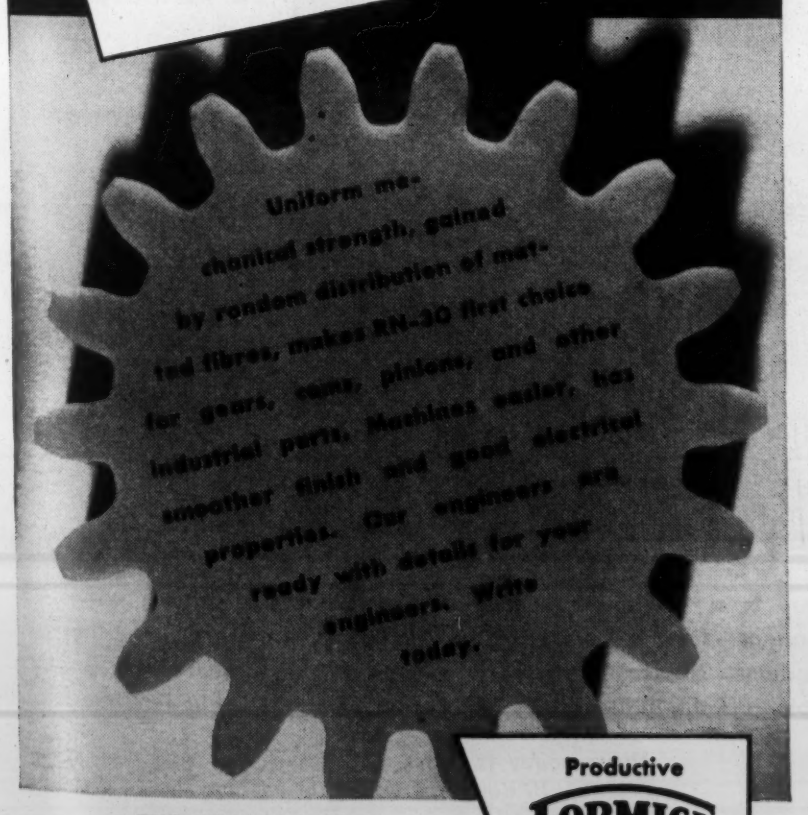
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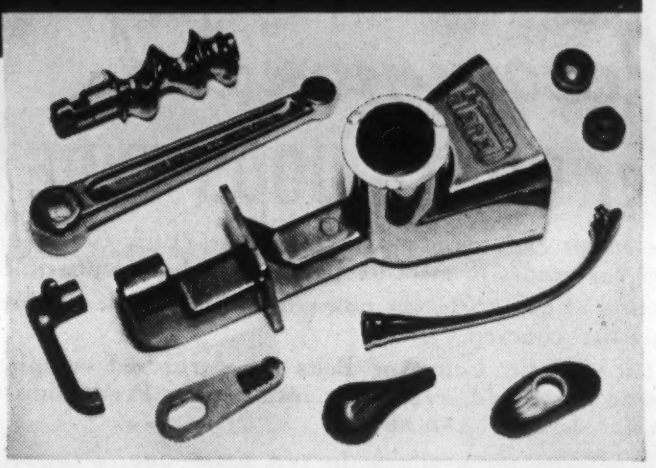

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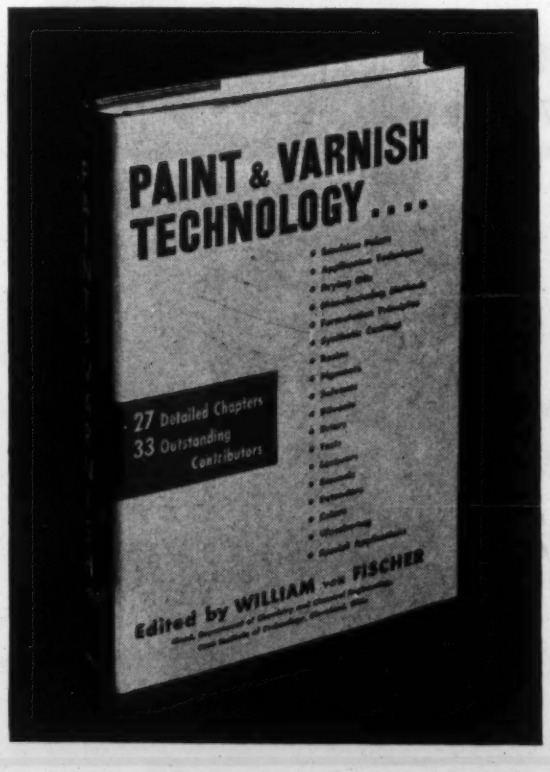

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31st National Metal Congress and Exposition, Cleveland, Ohio, October 17-21, 1949

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Acme Steel Co.	1836
Acme Tool Co.	1758
Affiliated Gas Equipment, Inc.	2844
Air-Flo Compressor Co.	1750
Air Force, Dept. of the	2715
Air Reduction Sales Co.	2126
Ajax Electric Co., Inc.	1901
Ajax Electrothermic Corp.	1901
Ajax Engineering Corp.	1901
Allen Mfg. Co.	1615
Allis-Chalmers Mfg. Co.	1215
Allison Co.	2008
Alloy Casting Div.	210
Alloy Engineering & Casting Co.	210
Aluminum Co. of America	2627
American Brake Shoe Co.	325
American Brass Co.	331
American Chain & Cable Co., Inc.	925
American Cyanamid Co.	1704
American Emblem Co.	1809
American Forge Div.	325
American Gas Association	2844
American Gas Furnace Co.	2745
American Machine & Metals, Inc.	1709
American Machinist	1428
American Manganese Steel Div.	325
American Metal Market	1118
American Non-Gran Bronze Co.	2819
American Optical Co.	1617
American Platinum Works	2242
American Pullmax Co., Inc.	2521
American Society for Metals	2759
American Wheelabrator & Equipment Co.	2016
Ames Precision Machine Works	2817
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Anker-Holth Mfg. Co.	2650
Applied Hydraulics	1621
Arcos Corp.	1125
Army, Dept. of the	2715
Aronson Machine Co.	2560
Arwood Precision Casting Corp.	2411
Aurora Metal Co.	1620
Austenal Laboratories, Inc.	931
Auto Arc-Weld Mfg. Co.	2566
Automotive Industries	1754
B-A Coupling Co., Inc.	1528
Baker & Co., Inc.	2419
Baldwin Locomotive Works	1033
Bastian-Blessing Co.	437
Bath Corp., Cyril	2138
Bausch & Lomb Optical Co.	432
Bishop & Co. Platinum Works, J.	2007
Black Drill Co.	303
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Bruning Co., Inc.; Charles	2101
Brush Beryllium Co.	2554
Brush Development Co.	1114
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Buehler Ltd.	513
Bundy Tubing Co.	1214
By-Products Steel Co. Div.	503
Campbell Machine Div.	925
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Climax Molybdenum Co.	338
Clinton Machine Co.	219
Coast Metals, Inc.	2329
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Commerce Pattern Foundry & Machine Co.	2015
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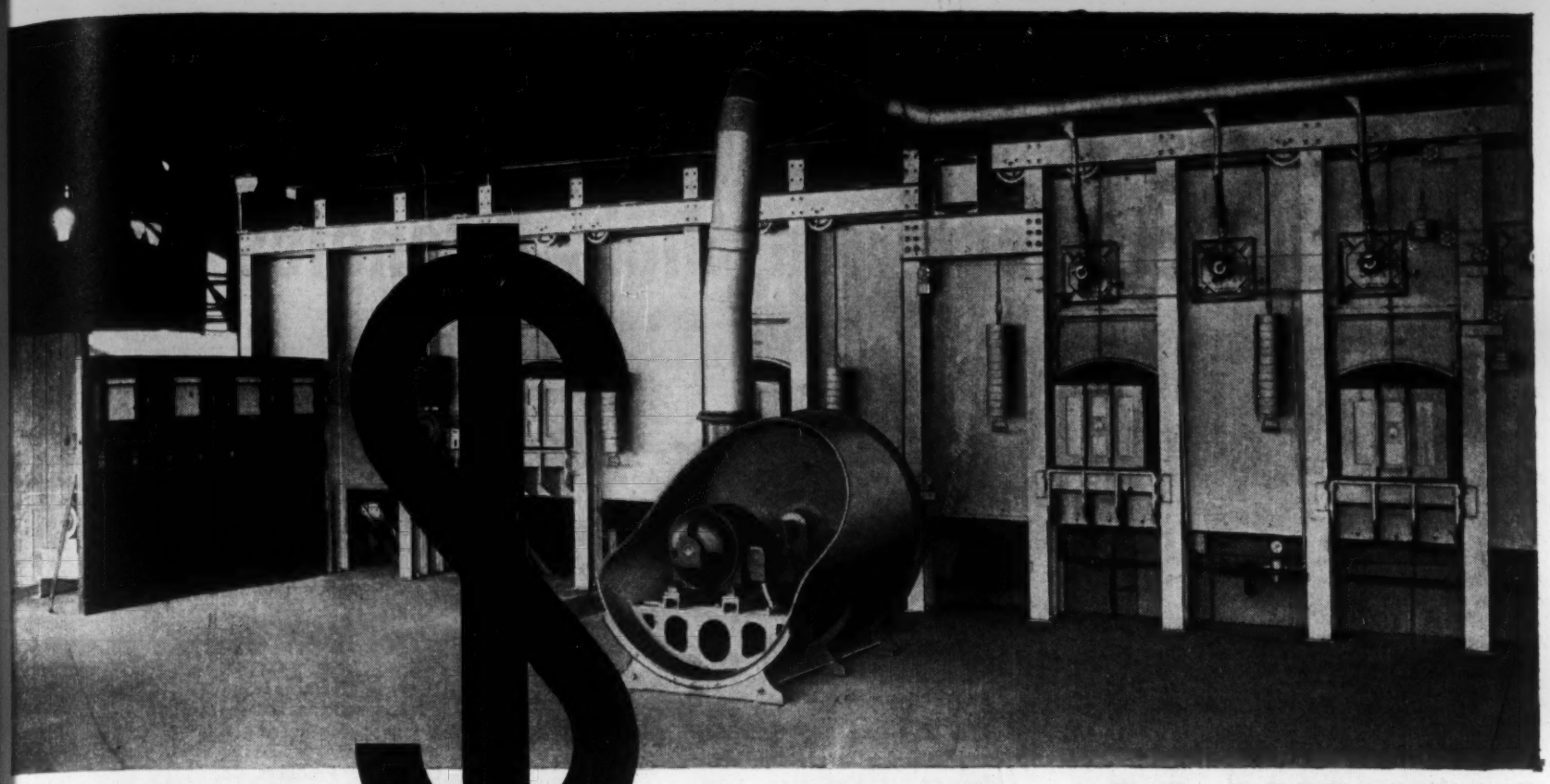

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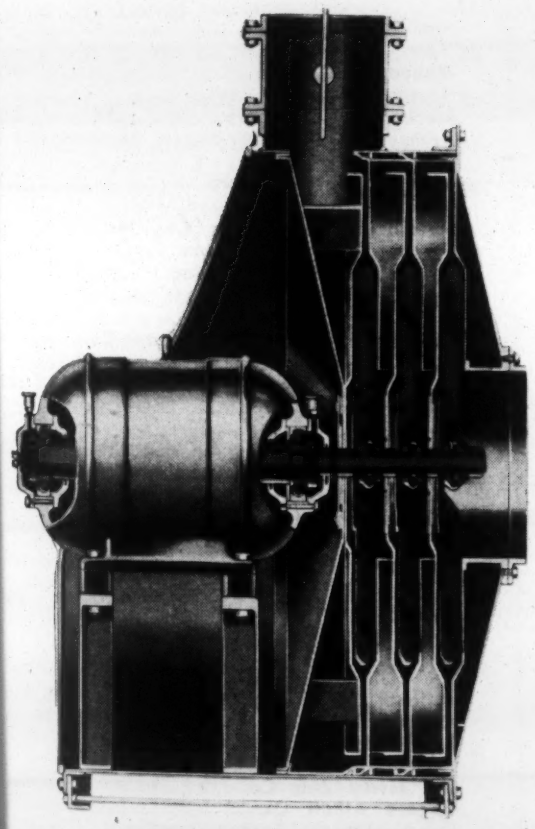

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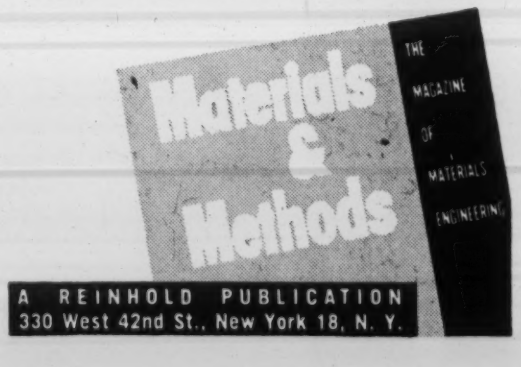

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EDITORIAL

Economy in Production

We are happy to know that this year's Metal Show is being built upon the theme "economy-in-production." Probably our pleasure stems from the fact that we feel that theme is the chief reason for the being of this magazine.

All of us will benefit if and when top managements can be shown that dollar savings are often economies of the lowest order. There are innumerable instances, for example, where a material that appears to be most expensive actually is cheapest because it offers results that cannot be obtained with lesser materials.

It is the duty of technical societies and technical publications to furnish their members and readers with the information that can help them sell real economy. Many exhibitors at the Metal Show are going to try to show how their products cut final costs.

We saw an interesting example just the other day. The product was a minute aluminum clamp that is an important part of a whole range of calculating machines. By most production methods the part in question could be produced by the thousands in a very short period of time. Consequently, they were cheap on a unit basis.

However, a new, slower and more expensive production method is now used to produce the parts. They cost much more than when produced otherwise. Still they really are cheaper.

Why?

Materials which could be used by the former standard methods of production, plus the necessary design of the part, did not provide sufficient strength to survive repeated shocks encountered in service. The part was vital, so its failure made the equipment on which it was installed useless. To replace the part required the attention of a trained serviceman.

By going to a material and method of production that cost at least twice as much as any former combination a saving of several thousand percent was achieved.

This, however, is just one phase of the subject. There is so much new in the way of improved processing equipment and materials that it is almost a full time job for anyone to keep up with progress.

We would like to salute the ASM for stressing this important subject today, and sincerely hope that those attending the Metal Show will find their time and effort well rewarded.

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Editor